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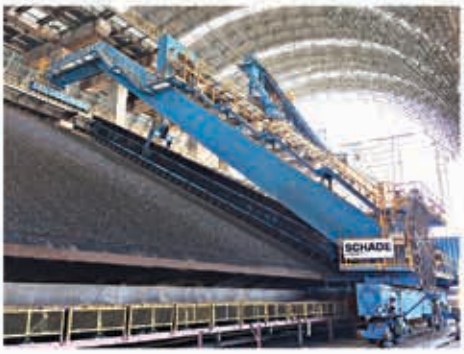

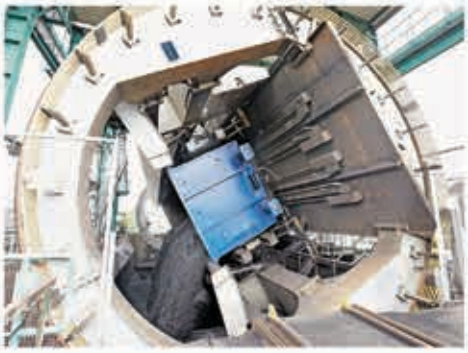

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Anglo's Mark Cutifani makes **the case for South Africa**

With 2019 fast drawing to a close as I write this, I can't help thinking that this past year has been an atrocious one for South Africa's mining industry, with our gold mining sector in precipitous decline, the country's image as a mining destination severely damaged, and very few greenfield mining projects underway or even in the pipeline. And, to cap it all, load shedding has once again reared its ugly head, impacting the whole country and, in particular, the mining industry.

It's at times like this that one is indebted to the optimists among us who point to the many positives of South Africa. One such person is Mark Cutifani, Anglo American's Chief Executive, who is a great believer in South Africa and its potential. At Anglo American's recent end-of-year media evening in Sandton, he argued that "South Africans don't give themselves enough credit for achieving the bold transition from apartheid to a democratic, inclusive and fair society."

He acknowledged that much remained to be done but said that it was "truly phenomenal that South Africa has built robust democratic institutions and expanded access to social services such as housing subsidies, public healthcare and education to millions of South Africans who were previously disadvantaged by apartheid."

He told his audience that South Africa – despite perceptions to the contrary – was Anglo American's best performing jurisdiction and added that it accounted for nearly half the company's earnings.

Cutifani – who, of course, hails from Australia – also stressed the importance of mining to South Africa. "Mining matters," he said. "It matters to the 58 million South Africans who benefit from the rich endowment this country has been blessed with – enabling the direct employment of half a million people and a further 4,5 million indirectly. Mining also matters because it is core to modern life. Our products are essential to almost every aspect of modern life. Through mining, we enable a cleaner and more electrified world."

He added that once the bedrock of the South African economy, and now its flywheel, mining was one of the very few industries that truly shared the value it created with its stakeholders and shareholders.

Turning to relations between the mining sector and the government, Cutifani sounded a positive note: "We have come a long way from a time when public discussion on mining was mired in mistrust and finger wagging. In this regard, it is important to give credit to Minister Mantashe and his team at the Department of Mineral Resources and Energy, who have brought a fresh perspective on the opportunities and challenges faced by the South African mining industry.

"We, of course, have our differences, and all of you here this evening know these well. These range from the debate about how we should approach what the lawyers call 'the continuing consequences of previous empowerment transactions' under the new Mining Charter to the need for South Africa to urgently revitalise crucial infrastructure. This applies especially to rail and port networks, and to bringing stability to Eskom so that the rich ore that sits beneath our feet can be exploited for the benefit of all South Africans, affordably and efficiently."

Mark Cutifani speaking at the Anglo American media evening in late November.

Concluding his speech, he said that as South Africa journeyed into its next quarter-century, it was important to remember that the path of any society is always rooted in progress, not perfection. "An aphorism from Confucius, China's most famous philosopher is appropriate: 'Better a diamond with a flaw than a pebble without.' Yes, South Africa has innumerable challenges but it is also, to borrow from Confucius, a diamond – one that has immense potential to shine ever so brightly. It is up to us to make this potential real."

While I'm not entirely convinced by Cutifani's argument about South Africa being a great mining jurisdiction, his comments were a refreshing change from the commentary one normally hears about the country and certainly left me feeling more optimistic than I've been in a while, a feeling which I think was shared by many others who attended the event.

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Endeavour completes plant upgrade at Ity

Endeavour Mining has announced the successful completion of the 25 % volumetric upgrade of the carbon-in-leach (CIL) plant from 4 Mt/a to 5 Mt/a at its Ity mine in Côte d'Ivoire.

Following the commissioning of the 4 Mt/a plant in April 2019, Endeavour launched optimisation and de-bottlenecking work to increase the plant capacity by 25 % for a minimal cost of between US$10 and US$15 million. Integration of components to achieve the increased throughput was carried out during the scheduled maintenance downtime with the plant achieving an annualised throughput exceeding 5 Mt/a in recent weeks.

As part of the volumetric upgrade, the capacity of the following items was increased: variable speed drives for the primary apron feeder, vibrating grizzly and lime screw feeder, tailings pumping and decant return, high pressure gland water supply, tailings pumping and a second 50-t capacity oxygen plant. Upgrades to the tailings storage facility are ongoing.

Sébastien de Montessus, President and CEO, commented: "Building Ity on time and on budget has been a key achievement for 2019. With the plant upsize now complete, we are well positioned for 2020 and beyond. We believe the increased plant capacity will help accelerate the value created through exploration."

Endeavour also reports that it has successfully consolidated the full 125 km trend along the Ity Birimian belt with the acquisition of the Mahapleu tenement.

Mahapleu has been purchased for a minimal cash consideration and a royalty based on a sliding scale depending on the gold price (varying from 1 % below

The Ity CIL plant, which has now been upgraded (photo: Endeavour).

Maiden ore reserve estimate for mineral sands deposit

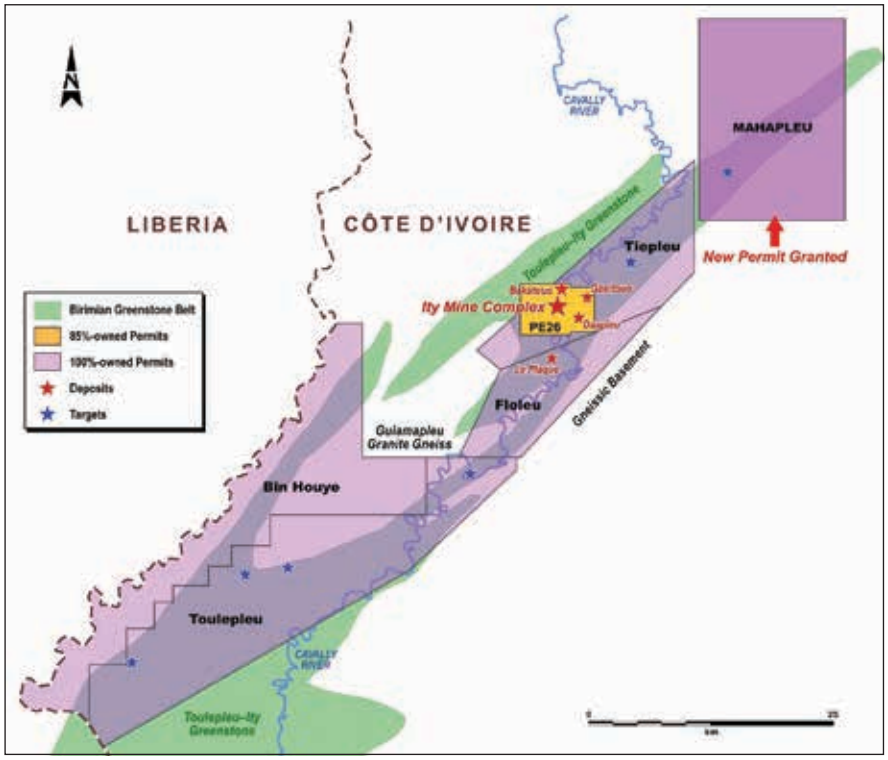
Base Resources, listed on the ASX and AIM, has released its maiden Ranobe ore reserves estimate which forms the foundation of its Toliara project in Madagascar. Reserves now total 586 Mt of ore at an average heavy mineral grade of 6,5 %, containing 38 Mt of in-situ heavy minerals (HM).

Base completed the acquisition of the Toliara project in January 2018 and, following positive findings from the Pre-Feasibility Study (PFS) completed in March 2019, is currently progressing the project through a Definitive Feasibility Study (DFS) phase due for completion in December 2019.

The Ranobe deposit is located approximately 40 km north of the regional town of Toliara in the south-west of Madagascar and 15 km inland from the coast. It comprises a single continuous body of mineralisation, comprising three units: the upper sand unit (USU), the intermediate clay sand unit (ICSU) and the lower sand unit (LSU).

The ore reserves estimate only comprises material in the measured and indicated resource categories from the USU. A 26 141 m drilling programme was completed over the course of 2019 with the samples currently being analysed. The aim of this programme is to increase the volume of mineral resources in the measured and indicated categories in all three mineralised units and provide a basis to update the Ranobe ore reserves estimate over the course of 2020.

According to the Ranobe PFS, Stage 1 development of the deposit would see a 13 Mt/a operation – consisting of a single 1 750 t/h dozer mining unit paired with a relocatable primary wet concentrator plant (WCP) – being established at a cost of US$439 million. Stage 2 would involve increasing the throughput of the operation to 19 Mt/a from year 3,5 onwards through the addition of a smaller 825 t/h dozer mining unit paired to a second fixed location WCP. Stage 2 capex is estimated at US$67 million.



Endeavour now controls the entire Ity Birimian corridor that extends over nearly 125 km.

US$1 200/oz to 2,5 % above US$1 850/oz).

An airborne Mag-VTEM survey was previously carried out on the Mahapleu tenement. The Mahapleu central area, known as Doui, appears to host a large intrusion which has the potential to be similar in type and size to the one associated with the large mineralisation event that occurred at the Ity mine complex. Endeavour expects to initiate ground surveys in early 2020.

"We are very excited to have consolidated control of the entire 125 km Birimian corridor along the Ity mine," said Patrick Bouisset, Endeavour's Executive Vice President Exploration and Growth. "The Mahapleu tenement is a highly prospective area which remains unexplored despite being located within proximity to the Ity mine. With our primary exploration objective of extending mine lives beyond 10 years for both Houndé and Ity well on track, we can now focus on increasing our greenfield exploration efforts in Côte d'Ivoire with Mahapleu ranking high within our large greenfield portfolio, alongside Fetekro."

Endeavour, listed on the TSX, is an intermediate African gold producer with a solid track record of project development and exploration in the highly prospective Birimian greenstone belt in West Africa. It operates four mines across Côte d'Ivoire (Agbaou and Ity) and Burkina Faso (Houndé and Karma). Projects in the pipeline include Kalana in Mali and Fetekro in Côte d'Ivoire. An updated feasibility study on Kalana is heading for completion while Fetekro is the most advanced of Endeavour's greenfield exploration properties. ■

Prospect increases reserves at Arcadia lithium project

Prospect Resources, listed on the ASX, has announced a significant increase in the ore reserve estimate of its 87 %-owned Arcadia lithium project near Harare in Zimbabwe, which further extends the life of mine.

An optimised DFS is currently being finalised to reflect this increased ore reserve. The optimised DFS will reflect the optimisation works that have been undertaken over the past 12 months to better reflect the economic potential of the Arcadia project.

The upgraded ore reserve of 37,4 Mt grading 1,22 % Li_2O and 121 ppm Ta_2O_5, which represents a 39 % increase on the ore reserve announced in December 2017, incorporates updated pricing provided by Benchmark Minerals Intelligence following the completion of the low iron petalite market assessment in July 2019 and updated petalite recovery in line with recent testwork developments.

Prospect Managing Director Sam Hosack said: "The Prospect team have worked tirelessly to extract the maximum value from the Arcadia deposit; with technical support from CSA Global, we have added significantly to our inventory and reinforced the strength of Arcadia's project economics.

"This incredible result confirms Arcadia as a globally unique and significant lithium deposit to supply the glass and ceramics market with technical grade ultra-low iron petalite. We see the battery market as a key driver of lithium demand growth but remain focused on the glass and ceramics market where Arcadia seeks to become a significant, consistent and reliable high-quality supplier and access the premium prices available in this market." ■

Teranga Gold to acquire Barrick's Massawa project

It is envisaged that the Sabodala processing plant, seen here, will treat ore from Massawa (photo: Teranga).

Teranga Gold Corporation, listed on the TSX, has entered into a definitive agreement which will see it acquiring a 90 % interest in the Massawa gold project from a wholly-owned subsidiary of Barrick Gold Corporation and its joint venture partner, Compagnie Sénégalaise de Transports Transatlantiques Afrique de l'Ouest SA (CSTTAO).

Massawa is one of the highest-grade undeveloped open-pit gold reserves in Africa. It is located within trucking distance of Teranga's flagship Sabodala gold mine in Senegal, creating the opportunity for significant capital and operating synergies. The proximity of the projects and the combination of Sabodala's mill and Massawa's high-grade ore (the 'Sabodala-Massawa Complex') are expected to scale Sabodala into a top-tier asset.

"The Massawa acquisition is transformational for Teranga and – by creating a top-tier gold complex, the first in the country – an important milestone for the gold mining industry in Senegal," said Richard Young, Teranga's President and CEO. "We anticipate that production from the Sabodala-Massawa Complex, together with our Wahgnion gold mine in Burkina Faso, will increase Teranga's targeted consolidated annual gold production and reposition Teranga as the next multi-asset, low-cost, mid-tier gold producer in West Africa, one of the world's premier gold mining regions."

Total aggregate consideration for the transaction is US$380 million upfront plus a gold price-linked contingent payment. The consideration will be in the form of cash and common shares of Teranga and, following completion of the transaction, Barrick will hold approximately 11,45 % of Teranga's shares.

The historical mineral reserves base of the Massawa project is 2,6 Moz from 20,9 Mt at 3,94 g/t Au. This will augment Sabodala's mineral reserves base of 2,4 Moz from 55,7 Mt at 1,35 g/t Au.

Massawa's reserves are located within 30 km of the Sabodala plant, thereby reducing initial phase 1 and phase 2 capital costs included in the Massawa Feasibility Study previously undertaken by Barrick. Life of mine sustaining capital for Sabodala is expected to increase due to extension of the mine and processing life, mainly for mine equipment and additional tailings storage facility capacity.

Based on the historic Massawa reserves, with no changes to the existing mine and plant capacities at Sabodala, the Sabodala-Massawa Complex offers significant anticipated benefits, including targeting higher annual gold production with an optimised mine schedule that combines the existing Sabodala ore with higher-grade ore from the Massawa project. As a result, cash margins and free cash flows are expected to increase commensurate with the increased production.

Tablo Corporation, controlled by Teranga Director David Mimran, supports the transaction. Tablo is investing a further US$45 million with this transaction to retain an approximately 21,2 % ownership in Teranga.

"Since my initial investment in Teranga four years ago, I saw the opportunity to create a top-tier gold producer in West Africa," stated Mimran. "I expect Teranga's management team to quickly unlock the significant potential of Massawa's high-grade reserves and deliver value to shareholders and our Senegalese stakeholders for years to come. This acquisition represents an opportunity to expand Senegal's gold mining industry and contribute further to the development of the country and the communities we touch."

Barrick President and Chief Executive Mark Bristow said the group had been pursuing the best means of bringing Massawa – discovered by its legacy company, Randgold Resources, 10 years ago – to account for the full benefit of all stakeholders. The agreement with Teranga, which will realise the full value of this asset and create a substantial new West African gold mining company with significant African

Galane Gold enjoys a positive September quarter

Galane Gold, listed on the TSX-V, produced 8 435 ounces of gold and sold 8 538 ounces of gold at an average price of US$1 460 per ounce at its Mupane mine near Francistown in Botswana during the quarter ended September 30, 2019. The operating cash cost was US$1 026 per ounce.

Galane's subsidiary Galaxy, which operates in the Barberton area of South Africa, dispatched 537 tonnes of concentrate in the quarter with a payable gold content of 489 ounces. The revenue for the sales was offset against capital costs as Galaxy is still considered to be in pre-production.

Comments Galane Gold's Chief Executive Officer, Nick Brodie: "Another positive quarter for Galane as we continue to generate positive cash flows from Mupane coupled with the ramp up of production at Galaxy which saw it become cash positive from operations on a standalone basis in October. Both continue to be on target to meet their production objectives for the year." ■

ownership, is the outcome of this process.

"Teranga has the appropriate infrastructure and processing facilities approximately 25 km away from Massawa, and combining the orebodies and the geological prospectivity will add further benefits," Bristow said.

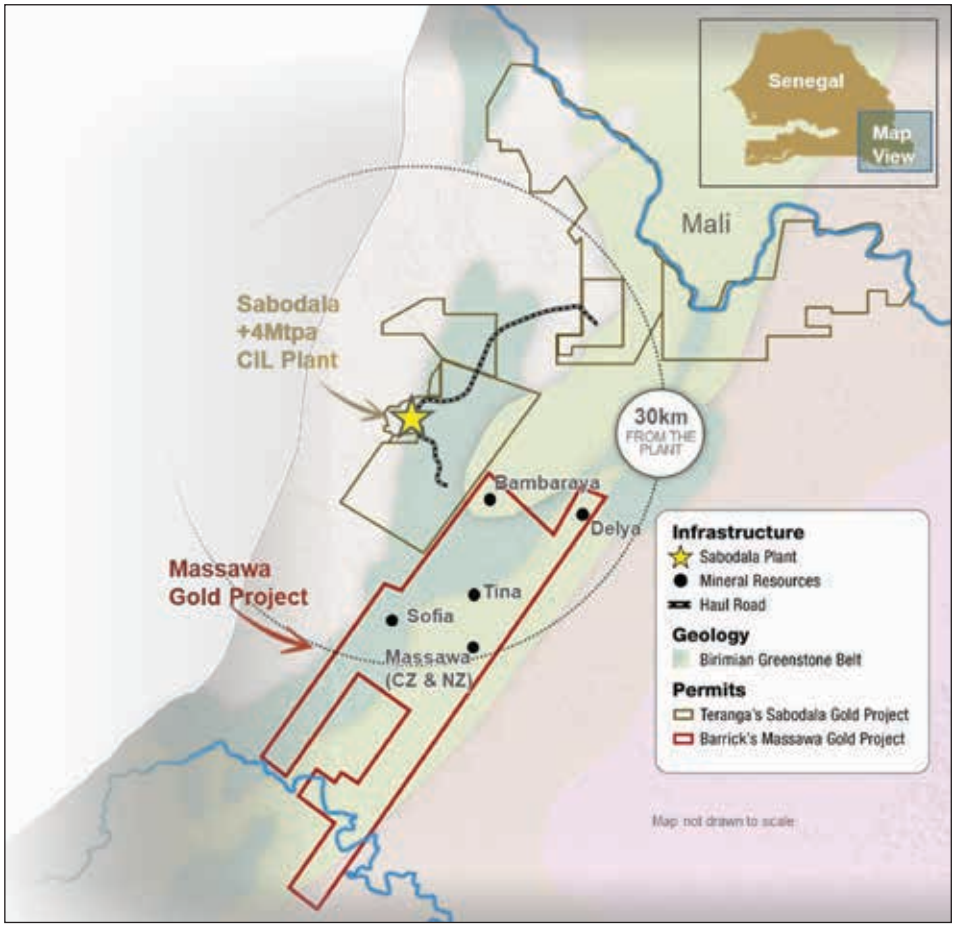
The transaction is expected to close in the first quarter of 2020 and is subject to receipt of the Massawa exploitation licence and residual exploration licence from the Government of Senegal, as well as certain other acknowledgments and approvals from the Government of Senegal including Teranga's integration plans for the Sabodala-Massawa Complex.

The Massawa Feasibility Study envisioned building all phase 1 and phase 2 infrastructure for approximately US$333 million and later adding a BIOX® circuit to process refractory ores in the later stages of the mine life for an additional US$80 million, for a total capital cost of US$413 million. The Massawa standalone operation was expected to produce an average of approximately 200 000 ounces of gold per year over the first 10 years.

Sabodala currently mines between 35 and 40 Mt of material and processes over 4 Mt of ore per year. Teranga plans to integrate the high-grade ore from the Massawa deposits into an optimised combined mine plan for Sabodala, leveraging its existing infrastructure, plant, mobile equipment and personnel.

Minimal changes are required to Sabodala's existing CIL plant and infrastructure to process free-milling ore from the Massawa project. This reduces the initial phases of capital costs included in the Massawa Feasibility Study. Teranga is targeting to commence processing free-milling ore from the Massawa deposits at its existing CIL plant in the second half of 2020.

Teranga intends to mine and process Massawa's high-grade reserves on a priority basis and it is anticipated that by 2021 more than half of the ore processed through the Sabodala plant could potentially be sourced from the Massawa deposits. Based on the Massawa Feasibility Study and Sabodala's current mine plan, the Sabodala-Massawa Complex is expected to increase Sabodala's existing gold production profile.



Location of Sabodala and Massawa.

Teranga and Barrick have invested significant resources in due diligence to gain a better understanding of the technical details of the Massawa orebodies to help Teranga develop an optimised, integrated mine plan for the two properties. This includes detailed resource modelling for the mineralogical characterisation, the chronology of metallurgical test work to determine BIOX® as the process of choice for the refractory ore in a retrofitted Sabodala plant and a revised life of mine plan that optimises the timing of the Sabodala and Massawa orebodies for processing as well as annual operating and capital costs.

This detailed due diligence work will form a basis for initiating a pre-feasibility study that Teranga plans to complete for the integrated Sabodala-Massawa Complex within six months of closing of the transaction. ■

The Moma mine showing WCP B (photo: Kenmare).

Kenmare receives approval for purpose-built road at Moma

Kenmare Resources, listed on the LSE and the Irish Stock Exchange, which operates the Moma Titanium Minerals Mine in northern Mozambique, reports that approval has been received for the Environmental, Social and Health Impact Assessment (ESHIA) for the purpose-built road to Pilivili from the Ministry of Land, Environment and Rural Development in Mozambique.

As part of its growth strategy to increase production to 1,2 Mt/a of ilmenite from 2021, Kenmare is relocating its Wet Concentrator Plant (WCP) B to the high-grade Pilivili ore zone in Q3-2020. The ESHIA for the road, which includes the power line, Heavy Mineral Concentrate (HMC) pipeline and related infrastructure, is the second of two environmental approvals required for the relocation of WCP B. The first approval for the Pilivili mining area was received in May 2019.

Kenmare had commenced construction of the road from within the existing Namalope permit area in late Q3-2019 and following receipt of the road ESHIA approval and forthcoming environmental licence, construction will commence along the remainder of the 23-km route. The project delivery timeline for the relocation of WCP B remains on track.

"The road ESHIA is the second and final environmental approval required for the relocation of WCP B to Pilivili. We are on track to relocate WCP B in Q3-2020 and begin commissioning in Q4-2020. Pilivili is the highest grade ore zone in Kenmare's portfolio and from 2021 we expect to have increased production and become a first quartile margin producer," comments Michael Carvill, MD of Kenmare.

Kenmare released the results of the Definitive Feasibility Study (DFS) for the relocation of WCP B to the Pilivili ore zone in June 2019 and said that the project, with a capital cost of US$106 million, had

Cora announces maiden resource for Sanankoro

Cora Gold has received a maiden pit-constrained Mineral Resource Estimate (MRE) from independent consultants SRK Consulting (UK) for its Sanankoro gold project in southern Mali. The MRE has been prepared in accordance with the JORC 2012 Code. This is an initial step in determining the overall potential of Sanankoro, which has a 1-2 Moz Exploration Target within 100 m of surface.

The estimate of 5,0 Mt at 1,6 g/t Au for a contained 265 000 ounces includes 4,5 Mt of oxide material (comprising hardcap, saprolite and saprock material) at a grade of 1,6 g/t Au, and 0,5 Mt of sulphide material at 1,8 g/t Au. Across the deposit, the base of oxidation ranges from 30 m – 125 m, with an average depth below surface of approximately 65 m. The open-pit shells used to constrain the resource extend to a maximum depth of 130 m below surface.

"We are pleased to announce the initial mineral resource estimate for Sanankoro, which was focused on the oxide, starter-pit, potential of the project, targeting the opportunity for a low-cost mining operation," comments Cora's Chief Executive Officer and Head of Exploration, Dr Jonathan Forster. "This estimate is the first step in defining the overall oxide potential at the project, where to date less than a quarter of the 1-2 Moz SRK Exploration Target has been tested. We have also been able to include a small amount of sulphide material in the MRE, confirming our belief that exploration expansion into the sulphide zones could provide significant future upside.

"We remain on track to deliver an initial Scoping Study this quarter. This study will assist in de-risking the project by establishing the framework for understanding the economics of a future mine development and also provide guidance for the on-going exploration programmes to maximise the delineation of further economic mineralisation." ■

been approved by Kenmare's board.

WCP B began mining the Namalope ore zone in 2013 and is expected to complete the current mine path in Q3-2020. All ore zones within the Moma portfolio were considered for the relocation of WCP B but Pilivili was selected due to the favourable combination of higher grades, strong co-product credits and free flowing sand with low slimes, enabling ease of mining and processing. Additionally, Pilivili is located 23 km from Namalope and the existing Mineral Separation Plant (MSP), allowing for ease of heavy mineral concentrate (HMC) transportation by pipeline.

Pilivili has a mine life of eight years, after which WCP B will mine its way to the adjacent ore zones of Mualadi and Nataka. Consequently, Kenmare believes that the relocation of WCP B from Namalope to Pilivili will be the only move of this kind that is necessary during WCP B's economic life.

The DFS was completed by Hatch Africa, a specialist EPCM consulting firm with strong experience in mineral sands, and overseen by Kenmare's project development team. It included an independent peer review process.

A number of different methods of relocating WCP B to Pilivili were considered, including disassembly/reassembly and alternate transportation options for the assembled plant by road and/or sea. Moving the assembled plant by road has the lowest risk profile and, accordingly, Kenmare will appoint a specialist heavy lifting and transport contractor to relocate WCP B and its dredge by road.

The contractor will use self-propelled modular transporters (SPMTs) to transport WCP B out of its mining pond at Namalope, along the purpose-built road, including a causeway estuary crossing into the new mining pond at Pilivili. ■

Record plant throughput at Yaramoko

TSX-listed Roxgold Inc mined 131 366 tonnes and achieved record quarterly plant throughput of 144 036 tonnes (which exceeded nameplate capacity of 1 100 tonnes per day) at its Yaramoko mine in the quarter ended 30 September 2019. Yaramoko is located on the Houndé greenstone belt in Burkina Faso.

Yaramoko comprises the 55 Zone mine and the nearby Bagassi South mine, which are both underground operations sharing the same plant. Bagassi South is the newer of the two operations, with commercial production having been achieved in September 2019.

During the reporting period, 34 200 ounces of gold were sold for US$50,2 million. The cash operating cost was US$510/oz produced and the AISC US$834/oz sold.

"Yaramoko had a good operational performance during the third quarter with the processing plant achieving record quarterly throughput and the mine achieving an operating cost of US$148 per tonne processed. In September, we reached commercial production at Bagassi South, bringing online our second high-grade gold mine at Yaramoko," said John Dorward, President and CEO of Roxgold.

"Looking ahead, increased stoping activity at Bagassi South and higher mined grades have driven strong operating results to start the fourth quarter, with approximately 16 000 ounces recovered at a head grade of 11,5 g/t in October. As a result, we expect to reach the lower end of our production guidance range for 2019." ■

The Bagassi South mine which forms part of Yaramoko (photo: Roxgold).

Mako diamond drilling delivers excellent results

Resolute Mining, listed on the ASX and LSE, has announced excellent drill results from recent exploration programmes in Senegal and Côte d'Ivoire on projects it acquired as a result of the successful Toro Gold transaction. The most significant results have been generated by diamond drilling undertaken at the Mako gold mine in Senegal which confirms the potential of a coherent high-grade lode at the north-eastern end of the Mako open pit.

The positive exploration results demonstrate the potential for mine life extension at Mako and build on the exceptional operating performance of the mine since Resolute assumed ownership. Mako produced 44 191 ounces at an All-In Sustaining Cost (AISC) of US$716/oz in the September 2019 quarter.

"The Mako gold mine has already outperformed for Resolute and positive exploration results are further confirmation of value creation," commented Resolute's MD and CEO, John Welborn. "The drilling results indicate strong potential to increase open-pit gold inventory at Mako which will extend the life of our new high-quality, low-cost operation. We are delighted to be operating successfully in Senegal and we are actively seeking to expand our tenement package to include new high-quality exploration prospects.

"A highly prospective and expansive exploration portfolio covering over 2 800 km^2 across Senegal, Côte d'Ivoire and Guinea was acquired as part of the Toro Gold transaction. In addition to the immediate opportunities for mine extension at Mako, Resolute has identified significant additional opportunities to source oxide mill feed for Mako within trucking distance of the existing processing plant. We are investigating possible joint ventures and acquisitions of highly prospective ground in eastern Senegal. Resolute is committed to creating value through successful exploration. We are actively progressing exploration activities in Senegal, Côte d'Ivoire and Mali seeking to add low-cost, high-quality ounces to our portfolio." ■

The Mako gold mine in Senegal (photo: Resolute).

Tulu Kapi gold project launched in Addis Ababa

AIM-listed KEFI has announced that its subsidiary, Tulu Kapi Gold Mines Share Company (TKGM), launched the Tulu Kapi gold project with its Ethiopian private and public sector partners at the Second International Ethiopian Mining Conference and Exhibition, recently held in Addis Ababa.

The project has gained significant momentum in recent weeks and, after many unfortunate delays, is ready for the start of development. It is supported by all consortium members and the Ethiopian Government at all levels. KEFI has strong local partners, principal contractors and an on-the-ground team.

The project's 24-month development schedule is expected to start in January 2020 and the project consortium action plan has now been agreed.

Recent developments have included the Ethiopian Roads Authority and the Ethiopian Electricity Power Organisation committing to a deadline for the new all-weather road and the power connection respectively. In addition, the government has committed to an aggregate cost for all the off-site infrastructure while the project contractors, Lycopodium and Perenti Global (formerly Ausdrill), have commenced procedures for locking-in contract pricing.

KEFI has now refined contractual terms for project construction and operation. Estimates include open-pit gold production of approximately 140 000 oz/a for a seven-year period. Projected all-in sustaining costs (including operating, sustaining capital and closure but not including leasing and other financing charges) remain at around US$800/oz. Tulu Kapi's ore reserve estimate totals 15,4 Mt at 2,1 g/t gold, containing 1,1 Moz.

A Preliminary Economic Assessment has been published that indicates the economic attractiveness of mining the underground deposit adjacent to the Tulu Kapi open pit, after the start-up of the open pit and after positive cash flows have begun to repay project debts.

KEFI has also announced that it has selected its preferred project infrastructure finance proposal. This is a bank loan based proposal recently received from two leading African banks as underwriters and lenders. ■

Wahgnion now in commercial production

TSX-listed Teranga Gold Corporation has announced that as of November 1, 2019 commercial production has been achieved at its second mine, Wahgnion Gold Operations. Teranga's new mine is expected to achieve the upper end of its 2019 production guidance of 30 000 to 40 000 ounces of gold after achieving first pour ahead of schedule in late August.

"The Wahgnion plant is running at or above nameplate capacity, recovery rates are well above 90 %, and costs are tracking in line with our 2019 guidance. With the successful ramp up to commercial production, Wahgnion is expected to finish the year at the upper end of its production guidance for 2019," said Paul Chawrun, Teranga's Chief Operating Officer. "Now that we have achieved commercial production, in the new year our attention will turn to conducting a reserve development programme focused on optimising the mine plan and adding reserves to extend the current 13-year mine life."

Located in south-western Burkina Faso, 510 km from the capital, Ouagadougou, and close to the border with Côte d'Ivoire, Wahgnion (previously known as Banfora) was acquired by Teranga in 2016 as part of its acquisition of Australian junior miner, Gryphon Minerals. It has been taken from exploration to production in less than three years without a Lost Time Injury (LTI).

A multi-pit, CIL gold operation, with a plant design modelled after the facility at Teranga's Sabodala mine in Senegal, Wahgnion will produce an average of 114 koz/a over its current life at an average all-in sustaining cost (AISC) of US$904/oz. During the first five years, however, it is expected that the mine will produce an average of 132 koz/a at an AISC of US$761/oz. ■

The processing plant at Wahgnion (photo: Teranga).

The processing plant of the Asanko Gold Mine in Ghana (photo: Asanko Gold).

Asanko Gold Ghana wins prestigious award

Asanko Gold Inc, listed on the TSX and NYSE American, has announced that for the second year in a row Asanko Gold Ghana (AGGL) has won the 'Mining Company of the Year' award from the Ghana Chamber of Mines at the annual Ghana Mining Industry Awards Ceremony. The company also received the 'Best Company in Exploration' and was first runner-up to 'Best Company in Innovation.' AGGL is a 50:50 joint venture between Asanko Gold Inc and Gold Fields Ltd.

"We are elated that for the second year in a row Asanko Gold Ghana has won such a prestigious award from the Ghana Chamber of Mines against very intense competition," said Greg McCunn, Asanko's Chief Executive Officer. "As a relatively young mine within Ghana, this award recognises the commitment

Resolute and Aggreko to partner on Syama power plant

Resolute Mining, listed on the ASX and LSE, is to partner with globally leading power generation provider Aggreko for the development of a new hybrid modular power station at its Syama Gold Mine in Mali. The new power plant will combine world-leading solar, battery and thermal generation technologies in one integrated power solution ensuring optimal efficiency, reduced energy costs and positive environmental outcomes.

Resolute has signed a Heads of Terms agreement with Aggreko for the development of the new Syama hybrid power station. The Heads of Terms set out the critical risk allocation and practical requirements which are required to be agreed between Resolute and Aggreko. A Power Supply Agreement (PSA) is expected to be entered into by the parties in due course which will regulate the timing and performance obligations and other key terms for the supply of energy to Syama.

"Identifying and adopting world-class technologies to improve our operations is fundamental to achieving Resolute's ambitions," commented Resolute's MD and CEO, John Welborn. "We are delighted to be partnering with Aggreko in delivering a lower cost and more environmentally friendly power solution for our Syama Gold Mine. The new Syama hybrid power solution will lower our power costs at Syama by approximately 40 % while significantly reducing our carbon emissions. Having worked together for several years, we know Aggreko is the right partner to support us as we integrate renewable energy into our Syama operation."

The new hybrid modular power station will deliver cost effective, environmentally friendly, capital efficient power and long-term electricity cost savings of up to 40 % (relative to Syama's existing power supply) while reducing carbon emissions by approximately 20 %.

The new plant will be delivered in two stages. Stage 1 is expected to be completed in 2020 and will comprise the installation of three new thermal energy Modular Block generators and a battery storage system. The new Modular Block units will be fuelled using a refined heavy fuel oil (IFO 180) and will be installed alongside the existing Syama thermal power plant to allow seamless transition to the new solution. Replacing existing diesel thermal generation at Syama with modern intermediate fuel oil thermal generation is expected to increase efficiency by approximately 30 %.

The new Modular Block units will provide 30 MW of power and will incorporate an additional 10 MW Y-cube battery storage system. The battery will provide spinning reserve displacement.

The second stage will consist of the installation of an additional 10 MW Modular Block in 2022 and the construction of a 20 MW solar power system. Once the solar power system is installed, the 10 MW battery storage system will also manage the solar power contribution to the power system and smooth out fluctuations in solar power output to facilitate integration into the hybrid system. The solar array is planned to be constructed on the surface of the existing Syama Tailings Storage Facility (TSF) thereby maximising positive environmental outcomes and augmenting Resolute's rehabilitation programme. The timeline on commencement of stage 2 will depend on the decommissioning of the existing TSF and is expected to be completed, at the latest, by 2023.

The site infrastructure layout of the new hybrid power plant will include space to accommodate an additional four 10 MW Modular Block units, enabling the mine to add additional power capacity if needed to support future growth. ■

that our team continues to demonstrate through its leadership in innovation in the workplace and ensuring we operate in a safe, socially and environmentally responsible manner."

"I am incredibly proud of our team for receiving these awards," said Fred Attakumah, Executive Vice-President and MD of Asanko Gold Ghana. "This is the highest recognition in Ghana for a mining company in the areas of health and safety, social and environmental responsibility and innovation and shows the tireless efforts and dedication of the entire Asanko Gold Ghana team. We will continue to seek further innovative ways of excelling in health and safety performance, respect for the environment and relations with our community partners."

The 'Mining Company of the Year' award is presented annually to the mining company that has achieved the highest aggregate results in the five categories of Occupational Health and Safety, Financial Performance, Corporate Social Investment, Local Content, Environmental Management and Innovation. ■

Substantial upgrade in Abujar gold resource

West African gold explorer Tietto Minerals, listed on the ASX, has announced further substantial increases in the mineral resource at its Abujar gold project in central-west Côte d'Ivoire. The new estimate is 45,5 Mt at 1,5 g/t for 2,15 Moz of contained gold, a 24 % increase on the previous estimate. The high-grade AG (Abujar Gludehi) resource now stands at more than 4 000 oz per vertical metre, suggesting potential for a high-margin, open-pit mining operation.

"We are very pleased to report that our Abujar gold project has moved into a select multi-million ounce club with gold resources increasing to 2,2 Moz at 1,5 g/t Au," commented Tietto's MD, Dr Caigen Wang. "This excellent result has been underpinned by rapid and effective drilling at AG since the last resource update in April 2019 that delivered wide high-grade intercepts on section after section.

"These high impact holes (from just 15 000 m of extensional drilling and 5 000 m of infill) have translated into a resource update at AG that has delivered on many fronts. We have increased our shallow high-grade core to 1,4 Moz at a higher grade of 2,2 g/t Au over a continuous 1,4 km zone. Our drilling has also increased the confidence of the resource estimate at AG. We now have just under half of the AG resource classified as indicated resources for 0,86 Moz at 1,8 g/t Au including 9,6 Mt at 2,5 g/t for 0,76 Moz from surface with these resources located at the northern half of AG.

"Our discovery costs are arguably the cheapest in the industry. We will be very busy in 2020 as our fleet of four company drill rigs are on track to deliver 50 000 m or more of drilling by Q3-2020, doubling all drilling at Abujar to date, as we target continuing rapid growth in our gold resource inventory. Gold mineralisation at AG and APG remains open and we will continue with our aggressive resource definition drilling as well as testing new targets over the 70 km strike of the largely untested Abujar gold corridor." ■

SRG awarded mining permit for graphite project

SRG Mining Inc, listed on the TSX-V, has been formally awarded the mining permit for its Lola graphite project near the town of Lola in eastern Guinea, West Africa. The 15-year renewable permit was officially granted by the Government of Guinea through presidential decree in conformity with the SRG's request of March 22, 2019.

"We are very pleased with the efforts and professionalism demonstrated by the Government of Guinea in support of this project. We see this as a reflection of the maturity of Guinea as a mining jurisdiction which recognises the importance of diversifying its mining resources," commented Ugo Landry-Tolszczuk, President and COO of SRG.

"With the receipt of the mining permit, we will now work closely with the Government in order to negotiate and finalise a mining convention in accordance with the mining regulations."

The Lola deposit is located approximately 1 000 km south-east of Conakry, the capital of Guinea. The deposit was named after the nearby town of Lola, located approximately 3,5 km to the east.

The deposit is present at surface over 8,7 km and has an average width of 370 m. The first 20 to 50 m (average of 32 m) of the deposit is well weathered (lateralised), freeing graphite flakes from the silicate gangue and thus allowing for easy grinding and optimal recovery of all large and jumbo flakes. Over 50 % of the graphite is large flake (+80 mesh), and 26 % is 'jumbo' flake material (+50 mesh).

Earlier this year, SRG announced the results of a Feasibility Study (FS) on the project, prepared by Montreal-based DRA/Met-Chem, a division of DRA Americas Inc. This details an open-pit operation – with a low strip ratio of 0,69 – with an average annual production of 54 600 tonnes of graphite flakes over a 29-year mine life. The estimated capex (including a power plant of US$5,8 million) is US$123 million. The pre-tax NPV (8 %) is US$277 million and the project has an IRR of 28 %. ■

Loading of 200-t bulk sample at Lola (photo: SRG Mining).

Tests on Goulamina ore improve on PFS results

ASX-listed Mali Lithium (previously Birimian) reports that further metallurgical testwork using Goulamina project ore has resulted in a significant improvement in results from those achieved in the project's Pre- Feasibility Study (PFS) in June last year (2018).

The Mali Lithium processing team has utilised innovation, experience and lessons learnt from recently commissioned lithium concentration plants to improve lithium recovery and product quality by focusing on four main areas:

- ❑ Substituting reflux classification technology for selective mica pre-flotation to remove mica from the final product.
- ❑ Utilising innovative technology from CRIMM allowing the use of 'High intensity permanent magnetic separators' to effectively remove Fe_2O_3 while minimising the corresponding loss of lithium.
- ❑ Selection of flotation reagents specifically tailored to maximise recovery of lithium from the Goulamina ore, based on experience of the metallurgical team and the Nagrom Laboratory.
- ❑ Elimination of Dense Media Separation (DMS), which has thus far formed part of the recovery process, as it will only produce a small volume of coarse product.

For this testwork programme, a composite sample of drill core from six previously drilled HQ (64 mm diameter) diamond drill holes located in the main and west pit was created. The sample had an average grade of 1,74 % Li_2O which is higher than the PFS reserve grade of 1,56 % Li_2O. This is a consequence of selection of drill core to provide a representative sample of ore from the first five years of mining.

While higher feed grades can be associated with more easily achieving the 6 % target product grade, the Mali Lithium team is confident that with the flotation testwork conducted and with further upcoming variability testwork, the excellent trends achieved in this round can be successfully replicated across a range of feed grades.

Water was shipped from the Goulamina site for use in the testwork to ensure realistic conditions and credible results.

Two separate batches of testwork were conducted. The first at the Nagrom Laboratory in Western Australia and the second at the Changsha Research Institute of Mining and Metallurgy (CRIMM) Laboratory in China. ■

Deep-South Resources reports on Haib testwork

Deep-South Resources Inc, listed on the TSX-V, has announced results from microbial-assisted column leach amenability tests performed on stockpile material from the Haib copper project in southern Namibia. The testwork programme is managed by METS Engineering of Australia and undertaken by Mintek in South Africa.

Two tons of feed material was collected for the testwork. The samples were removed from a stockpile extracted from an adit dug in the higher grade area of the main Haib deposit. The samples have not been weathered and are considered representative of the sulphide mineralised material at Haib.

Six 1-m bioleach amenability columns have been initiated at Mintek on -4,75 mm, -3,35 mm and -2,36 mm mineralised material. Copper dissolutions of 89 % to 96 % were obtained after 140 days.

Deep-South says it is important to note that the leaching is still active and that the results are not final until the leaching has terminated. The final results will be calculated from the assays of the solid residues at the end of the programme and will serve to confirm the final recoveries, after completion of the copper mass balances.

"These results are exceptional. The bio-assisted leaching results combined with grade upgrading mineral sorting results, HPGR and agglomeration are highly promising and demonstrate that we are on the right path to extract the metal at Haib and develop the project ahead," commented John Akwenye, Chairman of Deep-South.

The Haib head assay for the column tests revealed 0,73 % copper, 3,7 % sulphur with minor elements and the balance 28,4 % silica. There are no deleterious elements. The mineralogy of the milled Haib feed revealed that 98,5 % of the total copper content occurred as chalcopyrite, 1 % as bornite, and less than 0,5 % as chalcocite, covellite, malachite and chrysocolla.

High Pressure Grinding Roll (HPGR) optimisation tests have demonstrated that the hard Haib mineralised material is amenable to HPGR. A pressure of 60 bar is deemed suitable as the particle size distribution was not reduced once the pressure exceeded this value.

The mineralised material agglomerated without any issues. Heap leaching relies on the ability of the leaching solution to penetrate through the mound, around the mineralised material particles. When the mineralised material is not agglomerated, fine particles may vary in size and shape, reducing the ability of the solution to percolate efficiently through the heap, as smaller fines clog the spaces between larger fines.

An agglomeration drum was used to agglomerate the mineralised material and increase uniformity, making it easier for the leaching solution to percolate through the channels between particles to help maximise copper dissolution.

Based on these results, Deep-South is now planning the road map to the development of the project. On completion of the current metallurgical testwork, the first step will be to update the Preliminary Economic Assessment (PEA) completed in February 2018. ■

Orica to introduce WebGen™ to Africa's mining industry

ASX-listed Orica, the world's largest provider of commercial explosives, has a well-deserved reputation for innovation and, over the past several years, has introduced several 'next generation' products and systems that are transforming the field of blasting. Among them is WebGen™, the world's first wireless blasting system. According to Ravi Moodley, Orica's Vice President Africa, introducing WebGen™ to the African mining market will be a key focus for Orica's African operation in 2020.

Developed over a period of several years, and officially launched in October 2017, WebGen™ represents a revolutionary leap forward in initiation technology as it improves safety by removing people from harm's way, enhances productivity by removing the constraints imposed by wired connections, and is fundamentally changing the way blasting and mining is approached by enabling new blasting practices.

The technology has been the recipient of several awards, including the prestigious 2019 Austmine METS Innovation Award and the 2019 Mining Magazine Innovation Award for Drill and Blast. The judges described WebGen™ as a "gamechanger" and said the technology represented "not only a technological breakthrough, but also a step-change in safety and productivity in the mining industry."

Prior to its commercial introduction, WebGen™ was successfully trialled in full production conditions at the Ernest Henry Mine (EHM) in Queensland, Australia, an underground copper and gold sublevel caving operation. Since then, the system has been applied in several mines – including the Musselwhite underground gold mine in Canada – with demonstrations underway at many other customer sites around the world. Seven commercial services contracts have also been secured for the use of WebGen™. In all, more than 325 WebGen™ blasts have been fired globally.

A milestone in the application of WebGen™ occurred in October this year when 1 920 WebGen™ units were used in 534 holes to initiate a strata blast at the Poitrel coal mine in Queensland, Australia, which moved 1,3 million cubic metres of overburden

The Orica team in the Rosebank office. They are (top row, from left): Refiloe Masitsa – Human Resources; Thelma Mogorosi – Industry Analyst; Heather Holford – Finance Manager; Abhisek Roy – General Manager Africa South; Pontsho Maja – Operations Excellence, Engineering and Projects Manager Africa; Wim van Vliet – Supply Chain Manager Africa; Gerdus van Zyl – SHES Manager Africa; and Refiloe Kekana – Technical Services Manager Africa South. Seated from left are: Javier Cabeza – Business Development Manager Africa South; Gillian Hammond – Customer and Operations Support Africa South; Khutala Mcaba – Business Improvement Lead Africa; and Ravi Moodley – Vice President Africa.

WebGen™ – the world's first wireless initiating system. The WebGen™ system configuration consists of a wireless primer, an encoder controller, a transmitter controller, a fire system transmitter and an antenna.

– the largest open-cut blast to be conducted globally using wireless technology. This was the third blast in a trial series of blasts at the mine, which are on-going.

The system has not yet been deployed anywhere in Africa, but Ravi Moodley believes this will soon change. "Up to now we have worked on developing the WebGen™ supply chain, ensuring that the technology can be well supported in Africa," he says. "Now that it is a proven product, we believe the time is right to promote it to the continent's mining industry. Among other things, we will be featuring it on our stand at the upcoming Mining Indaba in Cape Town. This is a system that will offer huge benefits to many mining operations, both open-pit and underground, and we're confident that it will be well received in the African market."

In essence, WebGen™ provides for groups of in-hole primers to be wirelessly initiated by a firing command that communicates through rock, water and air. This removes constraints often imposed by the requirement of a physical connection to each primer in a blast and unlocks many safety and productivity benefits for customers by eliminating the need for down-wires and surface connecting wires.

Interestingly, the WebGen™ system communicates with the in-hole primer via Ultra Low Frequency (ULF) magnetic induction waves, which is the same technology that is used to communicate with submarines. The blasting sequence is stored in the primer during encoding, which is performed when charging the blast. All WebGen™ units require the correct unique signal to activate and then the correct signal to fire.

Moodley, who is based in Rosebank in Johannesburg, says that benefits of using the WebGen™ technology include increased ore recovery, increased productivity, reduced costs and, most importantly, improved safety. "Essentially, WebGen™ removes people from the workface, whether underground or on surface. It is the first explosive product from Orica to receive a Safety Integrity Level 3 (SIL 3) rating from TUV Rheinland, which is a world leader in inspection, safety testing and certification."

FRAGTrack™ – automated capture and reporting of fragmentation data. Lightweight F60 camera houses measurement sensors used in the determination of particle size distribution samples. F50 processing unit houses the edge computer processing and communication technologies used by the system.

A SIL 3 component running continuously is classified as having a safety critical failure rate of less than 1 in a 100 billion devices. This is the highest level that can be practically achieved for a commercial blasting product which makes WebGen™ the safest commercial explosive product in the world.

The current version of WebGen™, known as WebGen™ 100, has been focused on underground mining, but Orica is already working on WebGen™ 200, the next generation of the product.

Impressive as WebGen™ is, it is just one of an array of high-tech, digital-based products and systems from Orica that have been introduced over the past several years. These include: BlastIQ™, the latest version of Orica's cloud-based digital platform; the award-winning FRAGTrack™, a state-of-the-art fragmentation measurement tool; and ORETrack™, which allows RFID-based tracking of rock movement from the blast. All are making market inroads and there are now, for example, over 40 site implementations of BlastIQ™ worldwide.

Moodley goes on to say, "The goal of Orica is to digitally transform blasting and ultimately automate the entire drill and blast process to the point where we can completely remove the exposure of people while remaining competitive. We believe we've gone further along this road than any other

i-kon™ III electronic blasting system with Blaster 3000, Logger II, i-kon™ III detonator and duplex harness wire. The system fires 500 detonators per logger and up to 3 000 detonators per blaster.

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explosives company, with the key products being WebGen™ and BlastIQ™."

He adds that Orica has just announced that it will partner with Epiroc Rock Drills to jointly develop a semi-automated explosives delivery system, incorporating WebGen™, for use in underground mines. The first prototype system is expected in the next year with the first commercially available systems scheduled to enter service in 2021. "This collaboration represents a major step towards the goal of automating drill and blast operations," he states.

Turning specifically to Orica's African operations, Moodley says the group has expanded its footprint on the continent, with Mali and Burkina Faso – both experiencing strong investor interest – being added to Orica's portfolio over the past year, and with an additional major customer having been secured in the DRC. In addition, several long-term customers have renewed their contracts with Orica and have further committed their expansion plans to Orica technologies.

"We're now operating with a physical presence in 10 African countries, and apart from the Johannesburg office, we have offices in Lubumbashi in the DRC, Dar es Salaam in Tanzania, Chambishi in Zambia, Walvis Bay in Namibia, Accra in Ghana, Dakar in Senegal, Ouagadougou in Burkina Faso and Maputo in Mozambique. In total, we have close to 500 people employed across the continent, with a low reliance on expats to deliver our quality products and services. As an example, our Tanzanian business is 100 % staffed by Tanzanian nationals and, in other areas, our expats are from neighbouring African countries. While we will always draw from our great depth and experience in our global teams, the intention is to ensure that skills are passed on to our local Orica Africa team members as part of a sustainable skills model."

The focus in Africa outside of South Africa is to increase bulk explosives volumes with the supply of electronic blasting technologies and cyanide also forming an important part of the business. In South Africa, Orica mainly concentrates on the sale of blasting accessories and does not compete in the bulk explosives market at this stage. A product which it sees as having particular potential in the South African market is its i-kon™ III electronic blasting system (which it believes is the world's most sophisticated and safest system of its type) and there will be a renewed focus in 2020 on promoting this to South African customers.

"Our supply chain folks have done a great job to ensure a reliable supply chain into the southern region and we're very excited to be able to now supply this product at much higher volumes and support the customer base that has created such a 'pull' for detonators that are stable, reliable and immune to lightning and high temperature impacts," he says.

Moodley identifies Orica's mastery of logistics as one of the keys to its success in the African market. "Our supply chain is a really impressive operation and we are able to supply quality products anywhere in Africa – no matter how remote the site – on time and at competitive pricing. Yes, there are 'surprises' that come up every so often, but the teams are well briefed on their options and I am personally involved in coming up with customer solutions – we know our customers come first and we have the capability to ensure that we never miss a blast.

The Orica and Epiroc automation partnership aims to redefine underground drill and blast operations.

"We are also able to deliver ammonium nitrate niche products that are specifically developed for certain customers to address specific problems such as reactive ground or 'hot' holes. Our commitment is that we can fix any blasting or explosives related problems that our customers might have, drawing on our global experience and expertise which stretches back to the 1870s when Orica was founded."

Moodley also points to another strength of Orica which it is leveraging in Africa – the group's long-standing relationship with many of the world's leading listed 'blue chip' miners. As he says, "These companies subscribe to the same value system as Orica, which emphasises safety, transparency, good governance and an absolute respect for the communities in which we operate. They form a significant part of our customer base in Africa and it is no secret that we will continue to search for more customers with a commitment to safety and value systems similar to ours."

Orica's African operation falls within Orica's Europe, Middle East & Africa (EMEA) region. This is the smallest of the group's regions in terms of its contributions to revenues and volumes but is regarded as a growth area and has performed very strongly in Orica's 2019 financial year (to 30 September 2019) with revenues up by more than 9 per cent. Globally, Orica remains the world's biggest supplier of commercial explosives with its revenue totalling A$5,87 billion in FY-2019. The group works in more than 100 countries and has more than 12 000 employees globally. ■

"Our supply chain is a really impressive operation and we are able to supply quality products anywhere in Africa – no matter how remote the site – on time and at competitive pricing."

Pace picks up at Longonjo

Pensana Metals is making excellent progress on its Longonjo NdPr project in Angola. The results of a positive Preliminary Feasibility Study (PFS) were announced in November 2019 and the company is now following up with a full Definitive Feasibility Study (DFS), scheduled for completion in June 2020. A further drill programme to expand resources is underway and four containers with high-grade weathered mineralisation have been despatched to Australia for pilot plant testwork.

A major plus for the project is that it is located in an area which is well endowed with transport infrastructure. It is just 4 km from a modern rail line leading directly into the Atlantic port of Lobito while a sealed national highway lies 4 km north of the project and links the provincial capital of Huambo and its airport (60 km to the east) to Lobito.

The project will exploit what Pensana says is one of the largest high-grade rare earth deposits on earth, with the focus being on the NdPr content of the mineralisation. The current JORC mineral resource estimate is 226 Mt at 1,47 % Rare Earth Oxide (REO) including 0,33 % NdPr for 3,32 Mt of REO including 735 000 tonnes of NdPr. Pensana's intention is to initially mine the highest grade portion of the near surface weathered zone mineralisation.

Neodymium and praseodymium, collectively known as NdPr, are rare-earth metals which are in high demand as electric vehicles (EVs) become ever more popular and as the world shifts to renewable energy sources such as wind farms. Powerful NdPr permanent magnets are key components of both EVs and wind turbines. According to Pensana, an EV uses 2 kg of permanent magnets while a 5 MW offshore wind turbine uses around 3 tonnes.

The PFS was coordinated by international consulting engineering and project delivery group Wood, which is also undertaking the DFS. The PFS is based on open-pit mining and two-phase

Seen here on site at Longonjo are (from left) Pensana COO Dave Hammond, Geologist Benedito Madeleno and Site Manager Gavin Doyle.

Bulldozer clearing access to drill pads for the current drilling programme.

development of a 2 Mt/a processing plant and associated infrastructure, producing a NdPr concentrate for export. For the first three years of operation, it is envisaged that the project will process 1,5 Mt/a of higher grade resources, producing 60 000 tonnes of concentrate in each year and containing 4 600 t/a NdPr and 20 700 t/a TREO. From the fourth year of operation the front end of the plant will be expanded to process 2 Mt/a and maintain concentrate and NdPr production.

If these objectives are achieved, the mine would rank as one of the world's largest rare earth producers, second only to Lynas's Mt Weld operation in Australia, and the only major rare earths mine to be developed anywhere in the world since 2012. In Africa, it would be only the second rare earths mine of any significance. Rainbow has the Gakara project in Burundi but this is currently a small mine (although there are plans to ramp up its production).

The PFS estimates an upfront capital cost of US$131 million, including mine development, process plant and infrastructure, and a 15 % cost growth allowance. It would take an estimated 14 months to construct and commission the mine.

The open-pit mine, which has an average depth of 25 m and a negligible strip ratio, may be extended if infill drilling of some of the large amount of inferred mineral resources is successful. There is

Waterbore drilling at Longonjo in September 2019.

Reverse circulation drill rig at work in November 2019.

also the potential to extend the near surface blanket of weathered mineralisation in several areas where it remains open along strike through additional drilling.

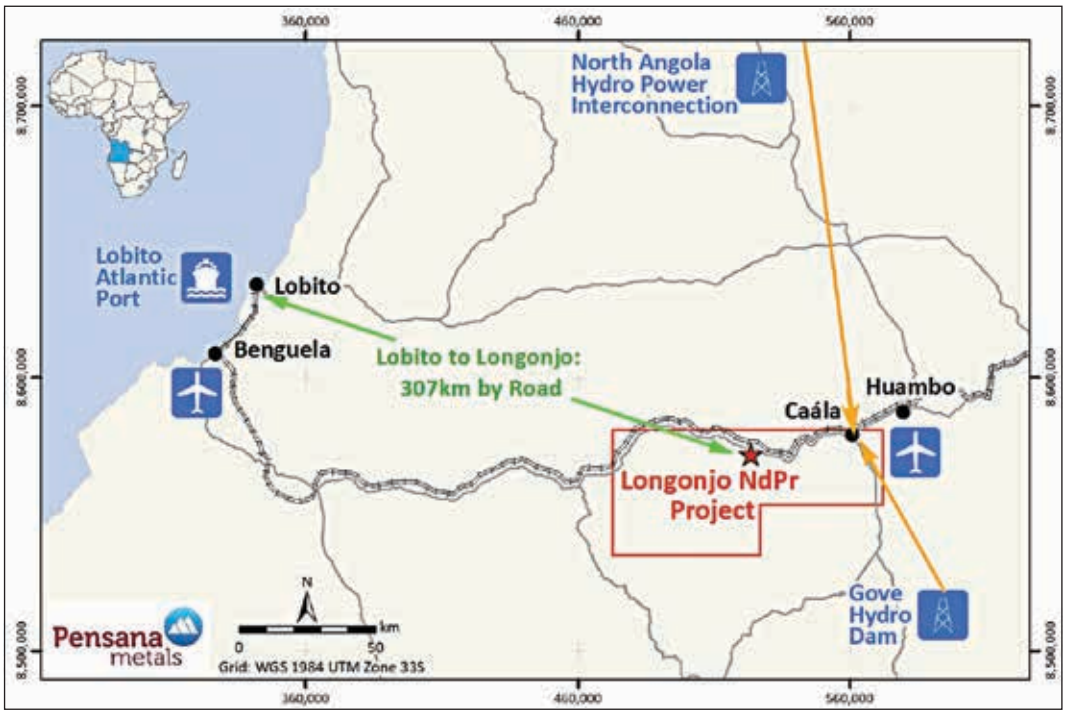
The thick blanket of friable mineralisation at surface lends itself to excavation with hydraulic excavators. Haulage of plant feed and waste to their respective destinations is proposed by small haul trucks. A bench height of 5 m has been selected to suit the geometry of the mineralisation and the readily available mining equipment. The benches can be mined in 2,5 m flitches, where it is warranted by increased selectivity. The plant feed will be hauled to the ROM pad and dumped on dedicated stockpiles. Plant feed blending is achieved by a front-end loader feeding the primary breaker.

Contractor mining is envisaged for the operation. Wood has identified reputable contract mining and earthmoving contractors with operations in Angola or the wider region, who have supplied budget quotes on the basis of preliminary mining schedules. Two contractors have provided quotations and nominated mining equipment. Both contractors nominated 70-tonne hydraulic backhoes as the main excavation equipment and either Mercedes Benz Actros 25-tonne payload tippers or Bell B45E 41-tonne payload articulated dump trucks.

The proposed plant will produce a high grade NdPr mineral concentrate to be shipped from the rail siding at Longonjo station located 4 km to the north of the project. The flowsheet adopted for the plant design is supported by testwork data and incorporates mechanical equipment with a proven track record in the industry. The plant design does not feature sophisticated control systems in keeping with the desire to have a plant that is simple to operate and maintain whilst being able to accommodate variable feed mineralogy.

The Longonjo flowsheet includes the following major process operations:

- ROM feed handling – mineralised feed receival and oversize rejection;
- comminution – open circuit primary milling followed by closed circuit ball milling and size classification using hydrocyclones;
- pre-flotation – removal of barite and other minerals;
- rare earth flotation – rougher plus four stages of



The Longonjo project is located adjacent to the US$1,8 billion Benguela rail line linking it to the Port of Lobito.

Drone shot showing the town of Longonjo with the Benguela railway line in the foreground (taken when the bulk samples were recently being loaded into the containers on the wagons visible at Longonjo station). Mount Chimbilundu, the carbonatite diatreme which hosts the Longonjo deposit, can be seen in the background.

flotation to produce a rare earth concentrate; and

- product dewatering – thickening and filtration of rare earth concentrate to a moisture content of 12 to 15 % by weight.

Pensana says it is designing into the project the highest standards of Environmental, Social and Governance (ESG) compliance from the outset. The main frameworks which have been used are the Equator Principles, the very highest environmental standards and Scope 1, 2 and 3 emissions under the Green House Gas Protocol (GHGP).

Access to low carbon power from the Luaca hydro-electric dam via the national grid and local PV and storage facilities at the mine site and the use of rail rather than road transport for the concentrates will give the mine a low carbon footprint.

The operation will use a closed circuit zero discharge process water circuit and a tailings storage facility designed to store benign tailings during operations which will be rehabilitated at the end of the mine life.

Pensana is currently listed on the ASX but is planning to list also on the LSE. Its biggest shareholder is Fidelity UK with a 9,9 % stake. The management team has extensive African experience and a strong project delivery track record. The Chairman is Paul Atherley while the CEO is Tim George and the COO David Hammond.

George was appointed in April 2019 to drive the project into implementation. He holds an honours degree in Minerals Engineering from Leeds University and his past career includes over a decade in production management at several Anglo American operations in Africa and involvement in plant design and feasibility studies in various base and precious metal projects. He is based in Cape Town and has previous experience working in Angola as Chairman and CEO of Xceldiam, an AIM-listed diamond exploration company based in Angola which was bought out by Petra Diamonds in 2007.

In its latest update on Longonjo, Pensana says that the four containers despatched to Perth in Australia contain 60 tonnes of high-grade weathered mineralisation mined from 23 locations across the initial mining area. The pilot plant testwork programme will produce approximately 2 tonnes of concentrate for delivery to customers ahead of offtake negotiations and will provide detailed parameters for the flotation circuit final design.

Pensana also reports it has engaged with a number of well-established mining financial institutions for the provision of a mezzanine finance facility to take the project from PFS through DFS to the main financing by the middle of next year (2020). In addition, the company has engaged in similar discussions with a number of financiers who have expressed interest in the main financing. These discussions are based on the completion of the DFS, the project being fully permitted and with offtake agreements in place.

Pensana has also commenced discussions with UK Export Finance which last year provided €450 million in export finance guarantees to UK companies investing in Angola and also with lenders who are actively lending to the oil and gas sector in Angola.

Whilst all the main commodity analysts are forecasting strongly rising demand for NdPr, Pensana emphasises it is not reliant on these outcomes as the project has a relatively low up-front capital cost, low operating costs and is strongly cashflow positive at the current (early December 2019) spot prices of neodymium oxide of US$41 000 per tonne and praseodymium oxide of US$48 000 per tonne.

Photos courtesy of Pensana Metals

Stacker installation highlights

Jacques Steyn.

The ability of thyssenkrupp Industrial Solutions South Africa to design, manufacture and install complex materials handling systems using mainly South African resources has been demonstrated by the recent commissioning of a 2 000 t/h stacker at a large open-pit coal mine in Limpopo Province. According to Jacques Steyn, the company's General Manager for Materials Handling & Mining Systems for Sub-Sahara Africa, the stacker was almost entirely designed and manufactured locally.

Steyn makes the point that many in South Africa are unaware of the depth of skills and expertise that still resides within South Africa's engineering sector. "One often hears that there has been an erosion of skills in the country and that there is no local capacity to build complex machines such as stackers or reclaimers," he says. "While it is true that there has been a loss of skills within certain organisations in South Africa, there is no question that this is a country which can still deliver world-class engineering as our installation at the coal mine illustrates. Certainly within thyssenkrupp's South African office we have an impressive depth of expertise, so much so that we often contribute to overseas projects being undertaken by our sister companies within the thyssenkrupp group."

He adds that another impressive aspect of the stacker project has been the ability of thyssenkrupp's local sub-contractors to manufacture and fabricate the components of the stacker using South African materials and deliver them on schedule to the high standards required by thyssenkrupp and the client. "We did not have to go outside the country for anything other than the motors, the slew bearings and a few other specialist items," he says.

The stacker was installed at an existing stockyard and thyssenkrupp had to meet some demanding requirements in terms of the machine's profile. In the event, it was constructed on site within a six-month

The 2 000 t/h thyssenkrupp stacker which was recently commissioned at a coal mine in Limpopo Province.

feature

South Africa's engineering skills

period without a single recordable incident, medical treatment case or Lost Time Injury (LTI) being recorded. "We pride ourselves on our unwavering commitment to safety, which was well demonstrated on this project," says Steyn.

Also in the mining field, thyssenkrupp Industrial Solutions South Africa is currently working on a 4 800 t/h semi-mobile in-pit crushing and conveying system for a coal operation in the Tete area of Mozambique which will reduce haulage distances at the mine. The installation incorporates one of the company's mineral sizers, as well as one of its large apron feeders.

"In-pit crushing and conveying is sometimes regarded as a very new development but in fact thyssenkrupp has been designing and building systems of this type for decades and ranks as a world leader in the technology," notes Steyn. "Our first installation in South Africa was commissioned as far back as 1981 at a Northern Cape iron ore mine and, until fairly recently, it was the lowest-cost-per-ton crushing system on the mine."

Discussing developments within the comminution field, which is closely related to materials handling, Steyn says that a revolutionary innovation by thyssenkrupp is the recently introduced Eccentric Roll Crusher (ERC), which he describes as probably the biggest step forward in crushing technology in the last 30 years. A versatile machine which combines the best features of roll crushers and jaw crushers, the ERC delivers highly efficient crushing capabilities to underground mines, mobile and semi-mobile crushing plants in open-pit mining as well as mineral processing plants.

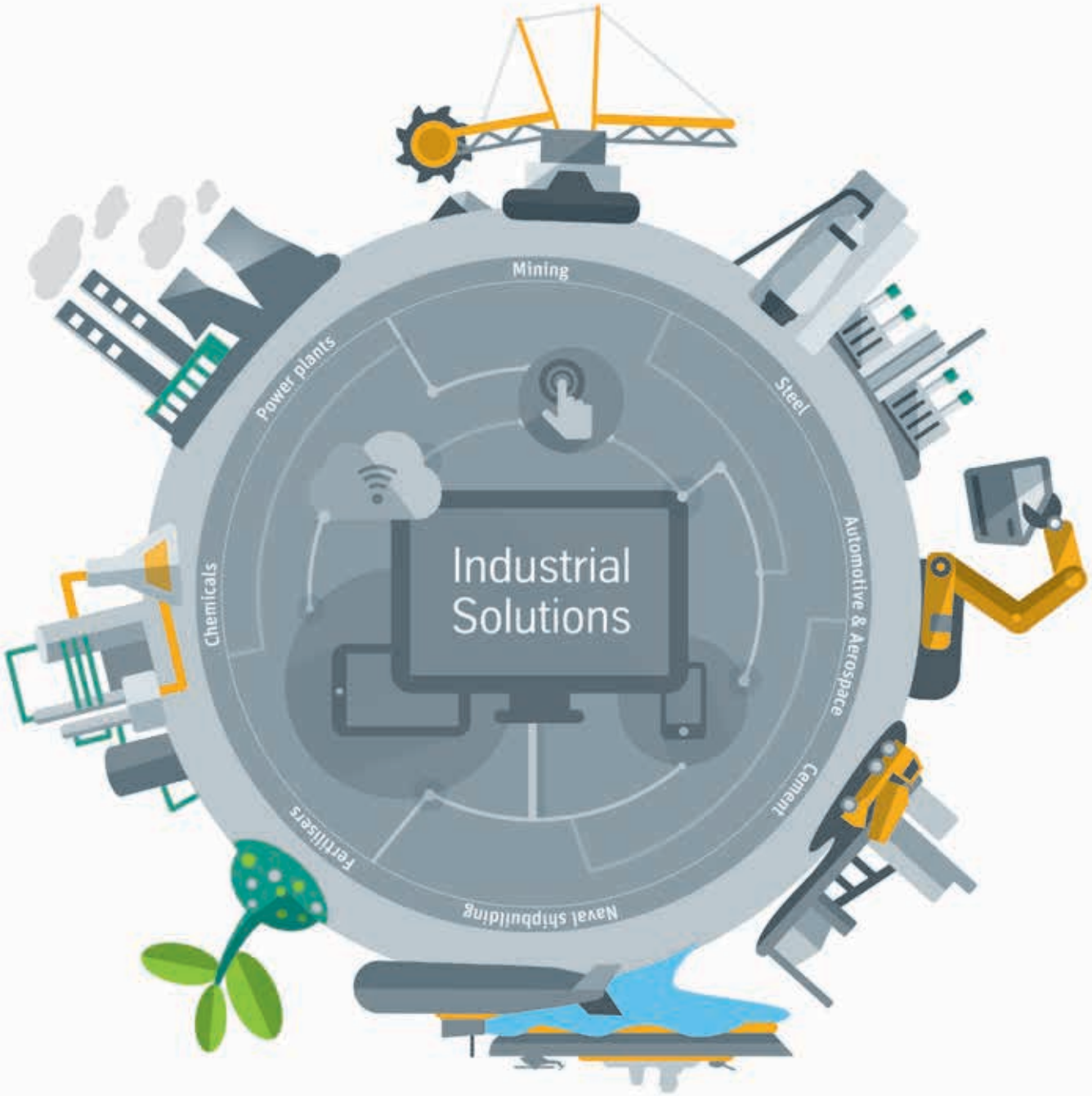
According to Steyn, the ERC's low profile and compact footprint is a particular advantage in underground applications as far less volume is required for the crushing chamber while in surface applications the height of the ramp and the tip can be reduced quite significantly. He says the ERC can handle the toughest rock and was specifically developed to compete in hard rock primary crushing applications where 350 MPa material is the order of the day.

The Eccentric Roll Crusher (ERC) from thyssenkrupp, one of the biggest advances in crushing technology in decades.

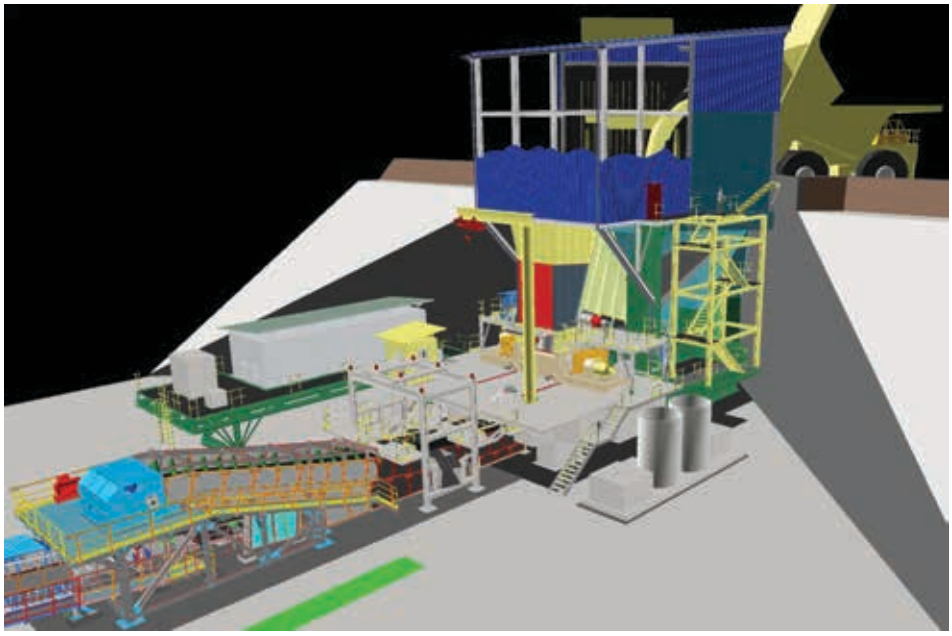
"The ERC was only introduced a few months ago and already there are commercial installations in Europe," he says. "We've only just started to market the machine in Africa but we're expecting it to do well, given its versatility and its ability to cut crushing costs. It really represents a step change in comminution technology and no other company has anything that is even remotely comparable."

On the subject of digitalisation, Steyn says that thyssenkrupp has been on a digital journey for years with the majority of its products and systems now digitally enabled and automated. "Most of our machines can now be remotely operated and indeed in Europe you would be hard pressed, for example, to find new thyssenkrupp stackers or reclaimers with operator cabins. We're also very advanced when it comes to stockyard management and optimisation. We combine material flow detection with pile scanning instruments to create a digitised 3D stockpile model that is updated in real time and allows multiple machines to work simultaneously on the same stockpile."

thyssenkrupp Industrial Solutions South Africa's full bulk materials handling range includes stackers,



reclaimers, spreaders, bucket wheel excavators, rail wagon tipplers, overland, plant and pipe conveyors and train and ship loading and unloading systems, allowing the company to offer clients a comprehensive pit-to-port solution if required (although projects of this scope are currently few and far between). The installed base of machines in South Africa is considerable, reflecting the fact that thyssenkrupp is this year (2019) celebrating 60 years in the country.



A typical thyssenkrupp in-pit crushing station.

Says Steyn: "Most of the major mining houses operating in South Africa are customers and our relationship with many of them goes back decades. The significant base of installed equipment is one of our strengths as it means we have a very healthy aftermarket business – the supply of parts and the servicing and refurbishment of machines – which sustains us during periods when there are few major capital projects around."

While mining is a key market for thyssenkrupp Industrial Solutions South Africa, other sectors such as power generation are also extremely important and indeed the company has been a major contributor to the two new large power station projects, supplying and installing coal stockyard equipment, including stackers and drum reclaimers, at both sites.

In terms of support to customers, a key part of the company's infrastructure is its service centre in Chloorkop, near Johannesburg, which operates 24/7 and is equipped to provide a full servicing capability for all thyssenkrupp brands and equipment. The site also accommodates a well-equipped Technical Training Academy, launched in November 2018 and representing an investment of approximately R28 million.

"Our motto is quite simple: Develop exceptional skills in Africa for Africa," says Steyn. "We train and qualify industry leading, quality, artisans for our own needs as well as for our clients as the shortage of properly qualified artisans is a problem all over Africa."

Looking at thyssenkrupp Industrial Solutions Sub Sahara Africa's strategy moving forward, Philipp Nellessen, CEO for Sub-Sahara Africa, says: "We are very proud of what we've achieved in the last 60 years in South Africa, creating a strong engineering and production hub, which even has its own Training Academy and we will continue to strengthen our local set-up. Besides that we will foster extension into the rest of Africa. We have always worked in Africa outside of South Africa but we are now putting a renewed emphasis on the continent.

"Following on the footprint we already have in Southern Africa in countries such as Zambia and Mozambique, we've established an office in Ghana, as West Africa is clearly a major growth area, particularly in terms of gold projects and bulk commodities such as bauxite, iron ore and manganese. We are also looking to establish a permanent presence in Kenya, where we see opportunities in industries such as cement. Our philosophy is that if you want to serve the African market, then you need a strong on-the-ground presence across the continent, close to our clients, and this is what we are currently putting in place," he concludes. ■

The thyssenkrupp service centre in Chloorkop, near Johannesburg.

feature

NEPEAN offers full turnkey service for conveyor systems

A company which is fast making inroads into the conveyor field is NEPEAN Conveyors, based in Roodepoort near Johannesburg, which can offer a full turnkey service – from engineering through to commissioning – to organisations needing conveying solutions. *Modern Mining* recently spoke to the company's General Manager, Willem Niemandt, to learn more about its product and service offering.

NEPEAN Conveyors in South Africa is part of Australia's Nepean Conveyors , which itself is a division of the NEPEAN Group, which was founded in the 1970s by David Fuller, a toolmaker by trade who started in business with a small machine shop. This has since grown into one of Australia's leading privately owned engineering, mining services and industrial manufacturing organisations, with over 1 200 employees and a global footprint. In 2017 NEPEAN acquired Sandvik's conveyor components businesses and the specialist conveyor systems business in Finland, a transaction which included nearly 200 000 m^2 of manufacturing operations across Germany, Brazil, Australia and Finland.

NEPEAN Conveyors ranks as one of Australia's most successful suppliers of conveyor and materials handling solutions and the South African company is intent on following in its footsteps and already has some impressive installations under its belt. These include many underground trunk conveyor systems with capacities of up to 4 500 t/h and drives in the megawatt range.

Recounting the history of NEPEAN in South Africa, Niemandt says the South African company was established in 1995, with its original focus being on the sale of OEM equipment such as winches, belt maintenance equipment and the patented BOSS coupling. "More recently, and in response to the weak market for conveyor components, we decided to go beyond sales and design and move

This conveyor, manufactured by NEPEAN in South Africa and exported to Australia, feeds a biomass boiler.

feature

into the manufacture of conveyor and related systems such as transfer stations and mobile radial stackers," he explains.

Niemandt, who was previously Engineering Manager with Sandvik Mining Systems Africa, joined NEPEAN in 2016 and a year later assumed his present position as GM. He has played a major role in setting up the South African manufacturing facility – which has 2 400 m² under roof – and is driving the move into the fabrication of complete conveyor systems.

Willem Niemandt at the NEPEAN manufacturing facility in Roodepoort. Note the BOSS coupling (on the right of the photo) under test.

"Being able to design and manufacture gives us a competitive edge," he says. "We can customise solutions for our customers and our turnaround time is fast, typically measured in weeks or just several months, with this including design, drafting, manufacturing and corrosion protection if required. Most of our customers undertake installation themselves but we can also handle this if the customer prefers. We don't have our own installation crews so we will sub-contract the work and closely supervise it."

He adds that NEPEAN employs the latest design techniques including Discrete Element Modelling, Finite Element Analysis and 3D modelling and also uses state-of-the-art conveyor design software packages. Manufacturing is to ISO 9001 standards.

NEPEAN South Africa's main market is underground and surface mining. "Initially, we were very involved in systems for coal mines but we have now broadened our service to include hard rock mines. Most of our customer base is in South Africa but we have worked much further afield, as far north in fact as Guinea and Senegal," states Niemandt.

One recent contract saw the company supplying two 200 kN belt clamps for a project in the DRC. The clamps were installed on a 1 500 mm wide inclined belt conveyor with a lift of 190 m with the clamps isolating the belt during its installation on the conveyor structure. The clamps are designed not to exert a clamping force of more than 2 MPa to prevent damage to the belt when clamped.

A fairly new market for NEPEAN is the refurbishment of conveyor structures and when *Modern Mining* recently visited the company's Roodepoort facility, the company was about to start work on the renovation of a system from a local coal mine. "With fewer greenfield-type projects around, mines are having to get the most out of existing assets, so we foresee refurbishment becoming an increasingly important part of our business," says Niemandt.

Looking ahead, Niemandt is optimistic about prospects for the company. "Our decision to manufacture complete conveyor systems has been a successful move. Business conditions remain constrained but we are definitely on an upward path in terms of turnover and revenue. We also intend expanding our African business. We've already shown we can work successfully all over the continent and further penetration of the African market will be a definite focus for us in the future." ■

Belt clamps in the Roodepoort facility ready for delivery.

Automated Flexicon system packages copper concentrate

Vale Canada Limited operates one of the largest integrated mining facilities in the world in Sudbury, Ontario in Canada, mining and processing ores containing nickel, copper and other metals.

The company's Sudbury mining complex has been in operation for over 100 years. Starting in 2012, the Sudbury plant undertook a billion-dollar Clean Atmospheric Emissions Reduction (AER) project to reduce sulphur dioxide stack emissions by 85 per cent.

Previously, Vale refined both nickel and copper in Sudbury, says Tom Zanetti, Senior Project Manager on the Clean AER project. After analysing the total life of the mines and the long-term projections of mine capacity in the region, the company decided to focus on nickel production and sell copper concentrate to other companies instead of refining it in-house.

Vale worked with Ionic Engineering of Lively, Ontario to design a materials handling system capable of packaging 24 to 32 tonnes/hour (t/h) of the copper concentrate into bulk bags by integrating a Flexicon automated bulk bag filling system into its existing process.

To handle the volume, Francois Nzotungwanimana, Operations Manager at Ionic Engineering and Project Engineer on the bulk bagging project, specified the dual bulk bag fillers, roller conveyors and a central pallet dispenser comprising the Flexicon system. In addition, Ionic designed the electrical and control systems, sourced labelling machines and other equipment, designed safety systems and performed the systems integration including programming, electrical and safety. The Ionic Engineering team also performed additional mechanical design and safety engineering.

Explaining how the copper concentrate is produced, Zanetti says the ore mined on site is first ground into a flour-like powder. A flotation process removes waste rock. The resulting bulk concentrate is sent to a smelter, which produces a high-grade material containing both nickel and copper. Another flotation process separates the nickel and copper concentrates. Vale refines the nickel concentrate into metal on site.

The copper concentrate, after dewatering and drying, has a texture similar to that of sand and contains 60 to 70 per cent copper. It is conveyed to two large feed hoppers positioned above the dual bulk bag filling stations, each hopper holding 10 tonnes, enough to fill five bulk bags.

Flexicon's Project Engineering Division integrated a pallet dispenser, pallet turntables, two 7,5 m long roller conveyors and two Swing-Down™ bulk bag fillers. The pallet dispenser is positioned between – and at a right angle to – the mirror-image bag filling lines.

Each bulk bag filler features an articulated Swing-Down fill head, allowing the operator to safely access all bag connection points from floor level.

A forklift loads 10 to 14 pallets at a time onto the pallet dispenser. When one of the bulk bag fillers calls for a pallet, the dispenser lifts all except the bottom pallet, which is sent to the left or right filler by the powered roller conveyor. A turntable then rotates the pallet 90 degrees to align it with the filler.

Once a pallet is in place, the filler's Swing-Down fill head lowers and pivots from horizontal orientation to vertical, positioning the discharge chute and bag strap hooks within reach of an operator standing on the plant floor. This furthers the plant's safety initiatives by eliminating the need to step on roller conveyors or strain to reach overhead connection points.

Once the operator places the bulk bag loops over automated latches, fits the bag spout over an inflatable spout seal and

pushes the inflator button, the filling cycle is fully automatic:

- The fill head pivots back to horizontal, raises to filling height and inflates the bag to remove creases.
- After several safety conditions are met, a knife gate valve opens, allowing the respective overhead feed hopper to gravity-discharge into the bulk bag at maximum feed rate, as displaced air from the bag is vented through a filter sock to contain airborne dust.
- At timed intervals, a densification deck below the pallet vibrates to stabilise the bag.
- Load cells continually monitor the weight of the copper concentrate as the bag is filled to a weight of 2 tonnes.
- The controller closes the knife gate valve, releases the bag loops and deflates/disconnects the spout.
- The powered roller conveyor moves the palletised bag out of the filler and onto several accumulating powered roller conveyors. The filled bag stops at the last accumulating conveyor where an automated labeller applies an identification label, before being rolled onto a gravity-feed roller conveyor toward a ramp that stops it in position for unloading.
- A forklift transfers the filled bags to a storage area, ready for shipment to customers.

Filled bulk bag is removed from holding bin at the end of the 7,5 m long roller conveyor.

In addition to fitting into the limited space available, the dual bulk bag filler configuration provides capacity, flexibility and redundancy for the bag filling process. Automatic pallet dispensing reduces wait time and the likelihood of worker injury.

Ionic Engineering designs and builds automation systems for mining, metals processing, and other industries. Besides this bulk bag filling system, Ionic has completed several other projects under the Clean AER initiative. ■

feature

TLT-Turbo redesigns its Auxiliary and Booster fans

Global ventilation fans and systems manufacturer, TLT-Turbo GmbH, has announced the redesign of its Auxiliary and Booster fan range. Developed in close collaboration with clients, the new designs address both efficiency and cost-effectiveness and meet the specific ventilation requirements of the mining industry.

The development of the new fan range concept began in early 2015. Following a lengthy global market study to gain an understanding of the market requirements, the range was defined in mid-2017, with the fabrication of the first units taking place shortly thereafter.

"The development of the Auxiliary and Booster fan range would not have been possible without the input of clients. This ensured that we focused on key market-driven requirements including energy efficiency, noise reduction, cost-effectiveness and turnaround time," says Michael Minges, Technical Director at TLT-Turbo Africa, who headed up the design of the fans.

TLT-Turbo started commissioning of the first iterations of the fan range towards the end of 2017 within the Sub-Saharan market through its Africa office. From there, they based the development of the various fan sizes of the new range on market interest. The fan designs and their performance validation were completed at the end of July 2019.

The new designs include several innovative additions to enhance performance in order to provide exceptional underground ventilation. The fan range was developed using the latest in engineering flow technology which allowed TLT-Turbo to improve the aerodynamics, and thus the efficiency of the fans. A unique stator design and aerodynamic fairings, all manufactured from wear-resistant composite materials, have resulted in improved efficiencies and reduced noise levels. The modularity of the fan casings allows for quick and easy assembly with interchangeable ancillary fan parts.

The new TLT-Turbo Auxiliary and Booster fan range is available to clients worldwide.

In addition to performance and efficiency, ease of maintenance was also a major consideration in developing the new range. The modularity of the product design and the interchangeable standardised parts allow for a quick turnaround time on parts supply.

"For example, we only have two blade types for the full product range and generally only one motor barrel per fan size accommodating various motor sizes and types. Standardisation on the product is the key to successfully managing maintenance and repair as it allows ample supply of spares for companies certified to do the repair work. The design track record has indicated a longer mean time between failure (MTBF) than previous products," Minges explains.

The fan range is being rolled out in phases. The preliminary testing at sites located in Sub-Saharan Africa has been launched successfully. The next phase is globalisation as the new range will be rolled out in the USA, Canada, Europe, Russia and Australia

TLT-Turbo Africa has received a number of orders for these fans since the end of 2017. These orders include South African clients seeking a solution for deepening a gold mine and for Kamoa Copper in the DRC as an exclusive supplier.

TLT-Turbo Africa, website: www.tlt-turbo.africa

Containerised substation supplied to DRC tin mine

Innovative and fit-for-purpose design was the winning formula that secured WEG Automation Africa, formerly Shaw Controls, the contract for a containerised substation and control room solution for a remote tin mine in the DRC.

According to Tyrone Willemse, Business Development Consultant – Projects and Contracts at WEG Automation Africa, the isolated location of the mine and the challenging logistics made the modular solution ideal for the mine. The substations are each housed in a 6-m high cube container. A total of 14 units was supplied, comprising MV rooms and LV rooms.

WEG Automation Africa has supplied a containerised substation and control room solution for a tin mine in the DRC.

"The units' dimensions and robustness had to allow for a long journey, including along a very difficult 200 km road to reach the mine site," Willemse says.

"Every part of the process plant has its own designated MCC that provides electrical power and control for areas including the primary crushing circuit, the plant feed, regrind mill, tailings thickener, and the product dewatering and handling circuits."

In addition to meeting safety compliance regulations, the design includes three-way locking systems, LED lighting, fire detection systems and a safety interlock to the fire system for air conditioners. Backup power supply is provided to all the exit lighting. To ensure easy cable entry, glanding plates were carefully located not to overlap with the container's support beams.

"Working in close collaboration with the engineering house, careful planning could be done upfront to ensure that nothing was overlooked," Willemse says.

"In the design, full consideration was given to the placement of elements like platforms, walkways, doors, viewing windows and air conditioning units. We also took responsibility for the logistics of getting everything to site."

Willemse says this turnkey solution demonstrates WEG Automation Africa's containerised substation design and engineering capability, as well as its full local manufacturing capacity lifting it above other MCC manufacturers or assemblers. The containerised solution comes with a full data pack, quality control documentation and an operation and maintenance manual in accordance with ISO9001.

Zest WEG Group: website: www.zestweg.com

GeoSLAM Volumes calculates stockpile mass

One of the global 3D mapping and monitoring specialists has announced a new innovative product to enable mine operators to quickly and easily build high-density 3D volumetric models within minutes.

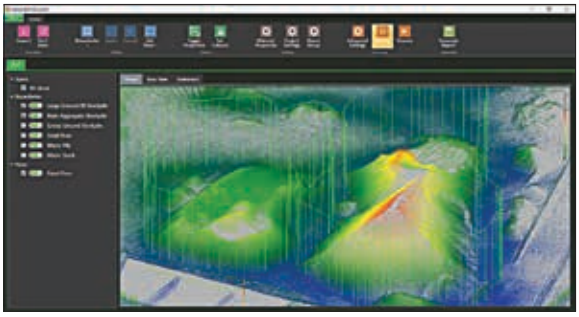
GeoSLAM Volumes is an end-to-end way to calculate stockpile mass, instantly turning stockpile point cloud data into actionable 3D information for quick decision making. This is achieved using the company's handheld Zeb Horizon SLAM (simultaneous localisation and mapping) scanner, which can be utilised on foot or with an UAV.

Using lightweight and easy-to-use scanners, the innovative solution can capture and calculate complex data, such as the weight and bulk of stockpiles, up to ten times faster than traditional tools. GeoSLAM Volumes enables volume calculations to be calculated as frequently as required at all stages of the supply chain without disruption to site activity or compromising employee safety.

"GeoSLAM has a long-standing pedigree around the world in the mining and quarrying industry and we're delighted to announce our latest solution to save time and reduce costs for mine operators," comments Matthew Bester, Mining Product Manager.

"GeoSLAM Volumes has been designed to democratise the laser scanning process in the sector. The beauty of our technology is that anyone can pick up our scanners without any previous training or understanding and have accurate, actionable data at their fingertips within minutes.

"We know that when companies are paid by volume, the need to deliver highly accurate measurements for 'just in time' supply chains is critical. Any mistakes can lead to delays, disputes or lost revenues, but we hope that GeoSLAM Volumes will enable mining professionals to manage inventories quickly, frequently and accurately so they can focus on other areas of their jobs."



GeoSLAM Volumes is an end-to-end way to calculate stockpile mass.

Utilising GeoSLAM's RobustSLAM algorithm, GeoSLAM's Zeb Horizon scanner was launched in 2018. It weighs just 1,3 kg and can scan 300 000 points per second at a range of 100 m with a relative accuracy of between 1 and 3 cm.

GeoSLAM, website: www.geoslam.com

Lifting equipment configured to order

Konecranes South Africa can supply overhead cranes and support equipment to customer requirements whilst still utilising standardised components through its 'configure-to-order' (CTO) crane design system and range of CXT wire rope hoists. Most of the lifting equipment design parameters specified by the customer can be digitally configured by the Konecranes engineers.

"Overhead cranes do not necessarily require specially designed parts and can be configured from pre-designed packages," says Konecranes SA's Managing Director, Emil Berning. "With specially tailored girder designs and trolley configurations, the CXT can fit into all kinds of buildings and lift almost any load up to 80 tons. The CTO process offers customers a more cost-efficient asset investment. The design time is reduced due to the utilisation of standard design parameters and criteria.

"Due to the fact that the manufacturing and assembly processes utilise standard design elements and components, it eliminates, for example, the need for rigorous safety, design and performance testing and accreditation that would be associated with equipment that has been engineered to order and requiring specially manufactured elements."

The Konecrane CTO process is said to offer a shorter lead time, a quicker delivery to the customer, and site commissioning in a matter of days. Financial savings can also be achieved due to the seamless CTO process.

Konecranes South Africa,
e-mail: NewTechnology.za@konecranes.com

Maptek launches short term planning tool

Maptek has built on its position as a leading developer of integrated technical solutions with the launch of Evolution Epoch, a short term planning tool.

Epoch adds to the proven Evolution capability for mid and long term schedules, working at the finest detail of the short term planning horizon. Opencut mines can now schedule holistically with a single system designed to maximise project value across the life of the operation.

The Epoch short term planning environment allows engineers to manage multiple mining activities, tasks and equipment, and apply different types of dependencies to define mining sequences.

In an impressive 40-year history, Maptek has broken new ground in areas from borehole logging and 3D geological modelling to mining-dedicated terrestrial laser scanning systems. Now it is reinventing mine scheduling by connecting short term planning to the resource model, as well as upstream mine design and downstream mine performance.

"We developed Evolution Epoch with a clear vision to ensure short term planners can build schedules that are practical, conform to mining constraints and remain aligned with long term scheduling goals," says Maptek's Mine Planning Product Manager, Eduardo Coloma.

Engineers use Epoch to produce viable schedules by simultaneously considering excavation, haulage and dump activities. Epoch delivers flexible and automated sequencing, schedule visualisation and dynamic reporting. Integration with the long term schedule and Vulcan mine plans ensures that plans do not focus on short term gains which result in long term losses.

Overview of the four main Evolution Epoch components: Viewer, Dashboard, Gantt chart and Destination Manager.

Mines need technical systems that are robust. The Evolution scheduling solution is dynamic and agile, minimising disruption to operations in the face of commodity, grade and resource fluctuations.

"Changing conditions require schedules to be rerun over and over, complicating the engineering task," says Coloma.

Having live links to datasets and being able to rapidly test scenarios makes stakeholders more confident in authorising adoption and deployment of practical short term schedules.

"The advantage of an integrated system is that everyone is able to work from the same data. As mid term plans are updated, short term planners can tailor their schedules to target these new plans," states Coloma.

"Data connectivity across the entire mine planning process minimises risks associated with data manipulation. Engineers can revise the haulage network in their designs and see the changes automatically reflected in Evolution viewer."

The live scheduling dashboard connects all departments across the mine. Engineers can analyse multiple sequences to guide activity execution and step forward in time across mine planning horizons to evaluate the impact of the current sequence.

Epoch was released alongside Evolution Strategy and Origin version 6. Strategy delivers new multi-element cut-off grade and capex optimisation functionality for maximising recovery and revenue to its suite of strategic optimisation tools. Origin generates detailed scheduling scenarios from life-of-mine to short term planning horizons.

Maptek, website: www.maptek.com

Caterpillar updates AC electric drive system for shovels

Caterpillar has updated the proven AC electric drive system for Cat® 7495 and 7495 HF electric rope shovels to deliver even greater reliability, improved maintenance access, enhanced safety and expanded ability to perform at high altitudes and in extreme temperatures. The updated system is also designed to easily integrate with advanced technologies.

"Caterpillar and our predecessor in shovel design and manufacturing, Bucyrus, have supplied more than 300 AC electric rope shovels," said Dale Blyth, Product Manager, Electric Rope Shovels. "The most recent advances in AC drives are integrated in this update and demonstrate how we apply our experience to help customers lower cost per ton and bolster safety."

Updates include a liquid-cooled motion regulator cabinet for more efficient dissipation of heat generated by electrical components. The new system enables shovels to operate at temperatures of -40 deg C to +50 deg C and altitudes of 5 250 m without derating. The reliable system also eliminates airborne contaminants in the cabinet and lengthens service intervals – for reduced costs and greater uptime. Additionally, a new, faster propel transfer switch cuts lag time by 75 per cent for improved productivity.

New technologies enable consolidating two cabinets in the machinery house to create space for easier maintenance access. The updated maintenance station is designed for integration of current and future technology solutions, including Cat MineStar™.

The new electric drive system will be on all new production 7495 and 7495 HF shovels beginning in late 2020. The system is not intended for retrofit, though some elements, such as the fast propel transfer switch, are available as upgrades to machines already in service.

Caterpillar is represented in Southern Africa by Barloworld Equipment, website: www.barloworld-equipment.com

A Cat 7495 electric rope shovel loads a Cat 797F truck in a demonstration.

Longer wear life at Africa's largest copper operation

Kansanshi mine has significantly reduced costs and improved productivity by applying Weir Minerals' Linatex® premium rubber lining solutions.

Kansanshi, Africa's largest copper mine, is located near Solwezi in Zambia. The mine is very remote, so getting parts and replacement material to site is time consuming and costly.

Of particular concern for the operation was excessive wear in the tailings lines, as well as the overflow tank in the continuous counter-current decantation (CCD) circuit.

There are approximately 8 km of tailings pipes running from the plant to the tailings dam. The mine had previously lined its pipes with a combination of HDPE liners and alumina ceramic tiles. These, however, only achieved a wear life of approximately nine months.

Kansanshi approached Weir Minerals Africa for an alternative solution and the company, which has a long-standing relationship with the mine, specified Linatex® premium rubber to line the tailings pipeline. Known for its outstanding wet abrasion properties, Linatex® rubber also requires a considerably shorter time for lining installation when compared to alumina ceramic tiles.

The lining was completed well within the allotted time, saving Kansanshi unnecessary and costly plant downtime.

After 36 months in operation, the Linatex® lining showed minimal signs of wear, and the installation has reduced the mine's total ownership cost by over R1,6 million per annum.

Kansanshi also needed a more cost effective wear solution for the overflow tank in the CCD circuit. This had previously been lined with alumina ceramic tiles, which only lasted between 60 and 90 days. The tiles were wearing away quickly due to the high impact and abrasion of the stones and sand flowing through the tank. Wash-out between the tiles was preventing the tiles from adhering to the metal substrate and the subsequent damage to the tank required repair work.

A tailings pipe lined with Linatex premium rubber.

In response, the Weir Minerals team specified Linagard® nitrile-based rubber (NBR). The expected cost savings from the increased production and reduced maintenance offset the installation costs.

The Weir Minerals technical lining manager was on site for the duration of the tank re-lining to provide technical assistance to Kansanshi's maintenance team.

Since installation, the Linagard® NBR 30 has lasted 36 months without any visible signs of wear.

Weir Minerals Africa: website: www.minerals.weir

Special coal-handling buckets boost productivity

The addition of special coal-handling buckets to the three SANY SYL956 front-end loaders acquired by Kusile Mining from Goscor Earth Moving has reportedly improved productivity dramatically at the company's two opencast mines. Kusile Mining is part of African Coal Trading (ACT), a 51 % black-owned junior mining company.

Kusile Mining operates Uitspan Colliery just outside Emalahleni, and Noodhulp Colliery close to Eskom's Hendrina Power Station. Uitspan supplies its run-of-mine material to Puleng while Noodhulp Colliery supplies Woestleen. Two of the three SANY SYL956H loaders have been deployed at Puleng, while the third works at Woestleen.

The bigger bucket loads a typical 15 m^3 tipper in three passes.

Brad Freeman, sales consultant for both brands under GEM, explains that having previously used rented front-end loaders, Kusile Mining recently decided to purchase its own equipment outright due to assistance from Goscor Finance.

The front-end loaders had to be supplied with special 4,6 m^3 coal buckets, as opposed to the standard 3,2 m^3 buckets. Mine Manager Dries van der Vlies explains that the bigger bucket loads a typical 15 m^3 tipper in three loads, compared with six or more with a standard bucket.

The relative density (RD) of coal is light at 1,2 compared to other materials such as sand at 2,7. "We took into account the lifting capacity of the wheel loader, the weight and dimensions of the bucket, and the specific weight of the material being handled," ACT Group Engineer Hendrik Pieterse explains.

This made it possible to equip the 5-t SANY SYL956H front-end loaders, with an operating weight of 17 100 kg, with the larger buckets, to allow for quick and precise loading, resulting in faster cycle times. It not only increases productivity, but reduces fuel consumption significantly.

The SANY SYL956 front-end loaders feature a Cummins Tier 3 QSL8.9 engine for maximum power, high efficiency and large displacement. A multipoint fuel injection system allows for instantaneous throttle response, enhanced fuel efficiency and reduced noise.

The customised Dana axis-shift transmission with electronic control system allows for automatic shifting and a 10 000 hour service life. A forward/reverse handle and fingertip control ensure operator comfort and ease-of-use, while the combination of solenoid valves and logic control means smoother shifting and a quicker response.

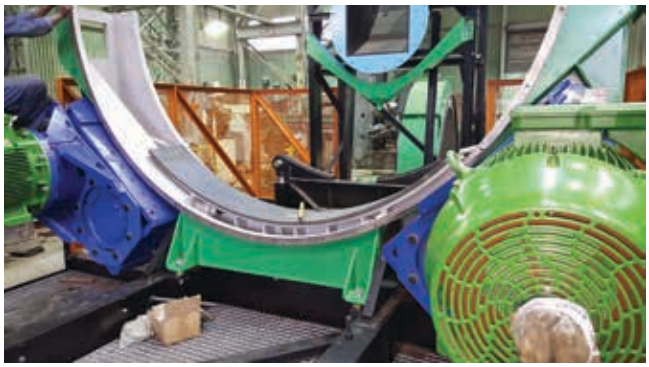
The load-sensitive hydraulic system provides for an excellent balance between speed and power, resulting in a 10 to 15 % energy saving. The high-pressure hydraulic system maximises displacement for a higher breakout and lifting force.

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

Vesconite used for hydrodynamic bearings

Mineral processing equipment manufacturer and designer MechProTech has introduced hydrodynamic composite bearings made out of Vesconite thermopolymer plates that are bent into a half moon or quarter moon shape.

These are used on the mills (which are used for the fine grinding of mineral ore) and scrubbers (which are used for the washing and dispersion of clays and agglomerated material, made up of fines and superfines) that it designs and manufactures.



One of the mechanical innovations in MechProTech's mills and scrubbers is the use of Vesconite hydrodynamic composite bearings.

The bearings run on an oil film so there is no surface contact between the bearing and the outside support for the mills and the scrubbers. As a result, there is no energy-consuming and grinding friction during operation, states MechProTech Sales Manager Wynand Boshoff.

"Vesconite is a sacrificial bearing that provides support. If the oil that the bearing runs on breaks down, there is no damage to our equipment," he says.

The advantages of using Vesconite are not limited to technological ones and also include cost, operational and logistic benefits.

MechProTech notes that the Vesconite hydrodynamic bearings are less costly in this application than white metal bearings, which can be six times more expensive than the thermopolymer bearings. The bearings are also hard wearing and grease free so they require little maintenance in an industry in which machinery downtime can be costly.

Vesconite, website: www.vesconite.com

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11th Annual

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-Moving from the integration to the development of Women in Mining

Researched & Developed By: ITC

Date: 19, 20 & 21 February 2020 | **Venue: Gallagher Estate, Midrand, Johannesburg**

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Principal Technical & Projects
DE BEERS GROUP MANAGED OPERATIONS

KEY STRATEGIES TO BE DISCUSSED

- Working toward collaborative workforce between the mining houses and government towards a sustainable mining sector
- Implementing measures set out by the Mining Charter III in empowering women
- Discussing innovation principles in Mining to encourage diversity
- Moving towards having women as business partners through Enterprise Development
- Discussing the current statistics and inclusion of women in mining over the past 11 years
- Relevant, effective and ground breaking leadership # 2020
- Looking at a collaborative approach involving all stakeholders to achieve "zero harm" to women
- Sustaining injury free workplaces through effective Health & Safety measures

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