

Integrated solutions extend Cullinan's working life

Highlighting the value of its Integrated Solutions offering, Zest WEG Group hosted a media tour to Petra Diamonds' Cullinan Diamond mine, which completed a R1.65-billion plant expansion last year. *MechChem Africa* attends and reports.



Juan Kemp.



Alastair Gerrard.

Juan Kemp says he is general manager of the world's most celebrated diamond mine in the world. "This is a truth," he begins, relating that on stating this at a recent Mining Indaba function, it was disputed by a gentleman who suggested removing the word diamond: "Cullinan is the most celebrated mine in the world!"

"We have a long history. Our diamond resource was discovered back in 1902, 116 years ago, and mining started one year later in 1903. Today, if you are up and running inside 10 years of a discovery, you are doing well," says Kemp.

Only two years later, in 1905, the 3 106 carat Cullinan diamond was found, which remains the world's largest gem diamond ever recovered, anywhere in the world. And in subsequent years, more than 800 stones exceeding 100 ct have been found, of which more than 140 stones are above 200 ct.

"This mine is the world's most important source of truly rare and highly prized blue diamonds and one of the world's largest diamond resources by value. On 30 June 2017, our in-situ diamond resource was valued at around 190 Mcts. Cullinan also plays a very important role in its local community and is dedicated to maintaining high environmental, social and governance (ESG) standards, which we use to ensure sustainability and ethical impact," Kemp says.

With only 30 significant kimberlite mines in production today, Kemp says that natural diamonds are rare and getting rarer. When Petra Diamonds took over the Cullinan Diamond Mine from De Beers in 2008, without investment and expansion the life of the mine was not expected to extend passed 2014.

"We decided to put in a new block cave, called C-Cut Phase 1, on the western side of the ore body, supplemented by a sub-level Cave (CC1 East) on the eastern side. The life-of-mine now extends to 2030 and, depending

on market conditions and other factor, we should sustain diamond mining at Cullinan for at least another 50 years under favourable operating and marketing conditions," Kemp predicts.

Based on Jan 2018 grade estimates, the expansion plan will take production to 1.6 Mcts by 2019, 1.5 Mcts from run-of-mine ore and a further 0.1 Mcts from recycling the tailings.

Access development commenced in May 2010 by extending the South Decline down to the C-Cut levels. Development on the C-Cut horizon started in April 2011 when rim drive development commenced on that undercut level and product level development started one month later. The first rings in the undercut were blasted in June 2015. In 2016, the construction of draw bells commenced on the new production levels at 839 level and the production shaft was deepened to 940 m below collar elevation.

In 2017, a 13 160 m ore-handling system was excavated, allowing for future ramp-up use of the full C-Cut footprint, and the ore shaft was completed and commissioned. The new Cullinan plant reached ROM nameplate capacity in November 2017 and steady state production of 4.0 Mtpa ROM is expected for the 2020 financial year which starts on 1 July 2019.

The new milling plant, which includes the first use in South Africa of autogenous grinding (AG) mills for diamond processing, increases the mine's capacity from the mine's main ROM feed and tailings to around 6.0 Mt per annum. The upgrade also includes the replacement of 151 conveyor belts travelling 15 km with 22 new belts conveying across just 3.0 km; 32 conveyor transfer points replace 179 existing ones; 22 screens replace 88; seven pumps instead of 121; a single HPGR crusher (excluding the AG mills) replace 18 cone crushers and mills; three new substations instead of 17; and 84 new electric motors that replace 589 older ones.

Electrical efficiency has improved by 12%, from 4.5 to 4.2 kWh/t, but the water efficiency improvement is most impressive with the new AG Milling plant reducing consumption by 66%, to 1.2 m³/t from the 3.5 m³/t through the pre-existing plant.

Zest WEG Group's Integrated mine solutions

Alastair Gerrard, Zest WEG Group Integrated solutions executive responsible for the



Group's energy, electrical infrastructure and packaged solutions portfolio, summarises the extensive nature of the electrical infrastructure required for the upgrade.

"The existing Eskom substation that used to feed energy into the mine via three 88 kV overhead lines was underrated" begins Gerrard. "This needed to be reassessed and a reliable solution developed to support the additional energy required for the expansion."

The solution developed involved the construction of a new high voltage (HV) 88 kV bulk substation dedicated to the Cullinan Mine. This substation would then be fed via a dual circuit 88 kV overhead line, which would be connected to the grid through the construction of a new Eskom self-build 88 kV switching station, located approximately 3.0 km from the mine's property.

"The Eskom 88 kV supply was diverted through the switching station to allow energy to flow directly to the bulk substation located on the mine's property. The bulk substation, which incorporates a complete protection system, comprises two incomer bays and three transformer bays, each equipped with 20 MVA power transformers. These transformers step down the voltage from 88 kV to 6.6 kV, which is then used to supply the mine's medium voltage (MV) network," he adds.

The designs for the self-build switching station were completed and provided by Eskom, while the complete bulk substation designs were completed by Zest WEG Group in accordance with Eskom specifications. Construction of both substations was executed by Zest WEG Group, the scope of which included the earthworks, terrace and

civil construction as well as, the erection of structures and positioning of all equipment. Furthermore, all the protection systems were installed and Zest WEG Group executed the commissioning scope associated with the project.

With integrated solutions division bringing the electrical infrastructure solution together, Gerrard went on to highlight the individual contributions of three other Zest WEG Group companies: WEG Transformers Africa (WTA); Shaw Controls; and ENI Electrical.

"WTA manufactured and supplied 26 transformers in total, with the three 20 MVA bulk substation power transformers being, at that time, the largest transformers ever manufactured by the Group in South Africa. In addition, other transformer sizes ranged from 10 MVA all the way down to 100 kVA units," Gerrard reveals.

WTA is also involved in the monitoring of the large 20 MVA transformers. This includes regular oil sampling, with samples being analysed at WTA's comprehensively equipped in-house oil laboratory. The advantage of regular oil sampling facilitates proactive assessment of transformer condition, allowing appropriate remedial action to be taken when necessary, thereby extending the life of these transformers.

Shaw Controls supplied six 525 V, 50 kA motor control centres (MCCs) in accordance to IEC 61439, as well as the two 6.4 MW, 3.3 kV MV mill drive packages, each with its own variable speed drive (VSD), motor and transformer. In addition, two 1.0 MW low voltage VSDs, 170 525 V field isolator stations and two containerised substations for the new



Above: In addition, Shaw Controls supplied six 525 V, 50 kA motor control centres (MCCs) in accordance to IEC 61439.

Left: The modern control room installed at Cullinan as part of the diamond mine's R1.65-billion plant expansion project.

Right: For the new autonomous grinding mills, Shaw Controls supplied two 6.4 MW, 3.3 kV MV mill drive packages, each with its own variable speed drive (VSD), motor and transformer.

7 Dam Pump Station were supplied.

"Our locally manufactured containerised substations are already well known in the market. For the project, Shaw Controls designed and supplied two containerised MCC solutions, incorporating WEG VSDs. All containerised solutions are manufactured at our facility and in accordance with ISO 9001 standards," Gerrard adds.

Eni Electrical, Zest WEG Group's specialist electrical, instrumentation and control systems construction company, was responsible for executing the project's installation scope. This included the installation of the dual circuit 88 kV overhead lines from the Eskom switching station to the bulk 88 kV substation on the mine and the construction of a 6.6 kV overhead line from the bulk substation to the new 7 Dam Pump Station. "In addition to the overhead line construction scope, Eni Electrical was responsible for the installation of all equipment, cabling, cable racking and cable terminations at various locations on surface as well as underground," Gerrard says, adding that the company also provided commissioning services.

"The mill expansion was the greater portion of ENI Electrical's scope as it took the



lead role in installing and commissioning the electrical equipment for the new AG plant," he notes.

"The Petra Cullinan Project was a very prestigious project for the Zest WEG Group and for Cullinan itself. Our integrated solutions approach, along with close collaboration and continuous interaction between all parties was key to the success of the project, which we believe proves our ability to deliver multiple integrated services in a highly effective way.

"We have a diverse product and solutions portfolio, which we believe places our Group in a strategically advantageous position to respond to the unique needs of our customers and, by working closely together with all parties involved, we look forward to many such successes in the future," Gerrard concludes. □