

E&MJ

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MINING JOURNAL

INCORPORATING:

World Mining Equipment

BAUMA PREVIEW

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*New Approaches
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Mine Power Systems

*Mining in the Philippines:
Revisiting the Rim*

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Gary Goldberg



Dr. Elaine Dorward-King

Newmont Mining Corp. announced that President and COO **Gary Goldberg** has been appointed president and CEO, and joined Newmont's board of directors. The company also appointed **Dr. Elaine Dorward-King** executive vice president of sustainability and external relations.

Cliffs Natural Resources Inc. announced **James Graham**, formerly vice president, general counsel-global operations has been appointed vice president and chief legal officer. **Carolyn Cheverine**, formerly general counsel-corporate affairs and secretary, has been promoted to vice president, general counsel and secretary. The company also announced that **Paul West** has been appointed director of corporate sustainability.



Marius Kloppers



Andrew Mackenzie

BHP Billiton recently announced that **Marius Kloppers** will retire as CEO and a director of the company in May. **Andrew Mackenzie**, currently BHP chief executive non-ferrous, will succeed him and join the board.

Silvercorp Metals Inc. announced that **Dr. Yi Huang** has been appointed chief mining engineer and

Guangrong Qian has been appointed deputy general manager of the company's operations in China.



Andrew Harding



Jean-Sebastien Jacques

Rio Tinto has appointed **Andrew Harding** as iron ore chief executive, replacing Sam Walsh who became Rio Tinto chief executive in January. **Jean-Sebastien Jacques**, formerly copper president, international operations, has been appointed copper chief executive, and will join the Executive Committee.

Duluth Metals Ltd. has appointed **Kelly J. Osborne** interim vice president of project development for the Twin Metals Minnesota project in north-eastern Minnesota.



Mike Westerlund

Hecla Mining Co. has appointed **Mike Westerlund** vice president of investor relations.

Ghana Gold Corp. has appointed **Kwabena Ata Mensah** principal geologist.

Equinox Copper Corp. has appointed **Corey Dias** CEO and **Dr. Patrick O'Hara** senior geologist. The company also announced that **Vic Nielsen** has resigned as president and COO.



Gerald (Jerry) H. Luttrell

Gerald (Jerry) H. Luttrell, the E. Morgan Massey Professor of Mining and Minerals Engineering at *Virginia Tech*, has been elected to the National Academy of Engineering. Luttrell's nomination was based on his advancement of separation technologies for the mineral and coal industries, pioneering new fields of technology in the environmentally clean processing of mined materials. He holds 18 patents, many of which are in commercial use.



Richard O'Brien

Boart Longyear Ltd. has appointed **Richard O'Brien** president and CEO.

Pershimco Resources Inc. has appointed **John Kapetas** vice president of exploration and **Octavio Choy** vice president Latin America.

Brookfield Resources Inc. has appointed **Richard Ratcliffe** director of operations.

Sunward Resources Ltd. announced that **Colin Andrew** has resigned as the company's CEO and director. He will be replaced by **Philip O'Neill** who is a member of the board of directors and a company founder.



Calvin Byers

Atlas Copco Rental has appointed **Calvin Byers** vice president of business development.

Drake Resources has appointed **Jason Stirbinskis** CEO.

South Boulder Mines Ltd. has appointed **Paul Donaldson** CEO.

Americas Bullion Royalty Corp. has appointed **Paul H. Zink** CEO.

Nemaska Lithium Inc. has appointed **Jean Francois Magnan** technical manager.

Sandvik announced that **Jonas Gustavsson**, currently president of Sandvik Materials Technology, has been appointed president of Sandvik Machining Solutions and **Petra Einarsson** has been appointed president of Sandvik Materials Technology and member of Sandvik's Group Executive Management.



Katherine Rogers



Victor Coetzer

Katherine Rogers has been appointed consumables marketing specialist for *Atlas Copco Construction Mining Technique USA's* Geotechnical Drilling and Exploration business line. **Victor Coetzer** has been appointed business development manager, store channel, for Atlas Copco CMT USA's Mining and Rock Excavation Technique Service division.

The NanoSteel Co. has appointed **Harald Lemke** vice president and general manager of the company's powder metallurgy business.



Frank Fetty



Mike Gissel

J.H. Fletcher & Co. has appointed **Frank Fetty** and **Mike Gissel** to its sales department team.

Smico/Symons Screens has appointed **Alan Odgers** vice president.

Oniqua MRO Analytics has appointed **Cayce Rivers** vice president of value delivery.

ARANZ Geo Ltd. has appointed **Richard Ertel** operations manager and **Bonnie Struthers** key accounts manager.



Jose Marin



Andrew Goldner



John Blich

Eriez announced that **Jose Marin** has been promoted to director of minerals and materials processing and **Andrew Goldner** has been promoted to senior manager-exports. The company also announced that **John Blich** has been promoted to director of corporate communications.

Cementation USA announced **Justin Oleson** has been appointed vice president of operations; **Bill Tilley** has been appointed director of engineering—USA and Chile; and **David Sabourin** has been appointed general manager of engineering and controls.



Ralf Kraemer

Klüber Lubrication North America L.P. has appointed **Ralf Kraemer** CEO.

Hill International has appointed **Albert V. Romano** vice president of the Project Management Group and head of its Phoenix, Arizona, office.

River Consulting has appointed **Tim Toth** director of automation services.

Niche Machines for Narrow-Vein Mining

While the world's major mines focus on bulk extraction, narrow-vein deposits demand a different approach—and different equipment. E&MJ looks at some of the possibilities.

By Simon Walker, European Editor



Boart Longyear reports that demand for its StopeMate drill has been increasing as more narrow-vein mines come on stream. It also offers the easily maneuverable StopeMaster rig, designed for bulk mining applications.

Go back a hundred years—150 certainly—and most of the world's mineral production came from narrow-vein deposits. Processing technology had not yet matured sufficiently to be able to handle bulk materials, flotation had still to be adopted for sulphide treatment and the introduction of the industrial-scale cyanidation processes that are today taken for granted as the prime precious-metals recovery route was still in the future. Mines had traditionally operated in a narrow-vein environment, even if veins ran *en echelon*, simply because the technology of the day would not allow anything more extensive. And, of course, waste-rock handling was minimized as mining was highly selective, keeping profitless dilution at rock-bottom.

The discovery of massive sulphide deposits, and gold plays such as the AJ near Juneau in Alaska—where block caving

was invented—changed all that, with new stoping methods being developed to extract them. Throughout the 20th century the focus tightened increasingly on higher-tonnage, lower-grade deposits as economies of scale in mining and processing broadened the viability range for orebodies. Add to that the realization that the epithermal vein systems that had been worked in the past were merely a near-surface expression of larger bulk resources below, and it is easy to see why the emphasis shifted away from narrow-vein opportunities.

Nonetheless, smaller mines worldwide continued to run on a more selective basis, with the major manufacturers keeping them supplied with equipment that was suitable for their constricted mine infrastructure. Looking back to the late 1980s, Tamrock, Secoma, Atlas Copco and several other suppliers all had drill rigs that were

designed specifically for small-scale development; Tamrock's MiniMatic and Secoma's Quasar were two examples of single-boom jumbos targeted at the small-mine market.

In addition, the introduction of rubber-tired jumbos to replace hand-held development drifters forced a re-think in terms of mucking technology. Tires and rails do not really mix in development headings, so small-capacity LHDs supplanted rail-mounted Eimco loaders and wagons.

The shift from pneumatic to hydraulic drilling also brought changes to the narrow-vein mining market, in that compressed-air ranges became less important within the mine infrastructure. Conversely, having more diesel-powered equipment in the close confines of a vein-mining system brought new ventilation challenges, while few narrow-vein mines today rely solely on shaft access; diesel vehicles need ramp access, as well as underground service facilities.

The high gold price in recent years has led to a resurgence in interest in small, limited-resource deposits that can be mined profitably using narrow-vein techniques. Lake Shore Gold's Bell Creek mine, near Timmins, Ontario (Reviewed in the February edition of *E&MJ*, pp.28–34), is one such, with a tightly constrained ore zone that demands both small development equipment and close sub-level spacing for long-hole stope drilling. A 2-yd³ LHD takes broken rock from the development ends and stopes to the transfer point on the main ramp, from where it is handled by larger loaders and mine trucks. And, even though the orebody appears to widen as it gets deeper, it is unlikely to warrant the use of much larger-scale equipment—apart from ramp haulage—for the foreseeable future.

Production Rigs for Tight Spaces

According to the company's global product manager, John Nielson, Boart Longyear's StopeMaster and StopeMate rigs are ideal for the tight and narrow spaces typically seen in underground mining operations. As a result, the company is seeing the demand

for these rigs increase as operations move underground. Each is specifically designed for underground applications, Nielson added, allowing for better access, mobility, flexibility and productivity in tight spaces.

Boart Longyear notes that safety is one of its key concerns, with the StopeMaster and StopeMate rigs having been developed with heavy-duty hydraulic hoses to protect the driller from hose rupture, and guarding for protection from moving parts. Removing the operator from the immediate drilling area, the rigs can be controlled remotely from up to 25 m away. They also come equipped with emergency stop circuits to cut the power to the drill in the event of an incident.

Both the StopeMaster and the StopeMate are equipped with a pneumatic top-hammer production drill that features 360° rotation for greater flexibility, together with a rotating/pivoting traverse. This configuration ensures precision drilling in both parallel and straight applications, and accurate operator control in drop-raise, cable-bolting, fan-drilling, ring-drilling and parallel-drilling applications, the company says.

Both rigs are skid-steer, mounted on four solid-tired wheels, with a four-wheel independent drive and braking system. With 30% gradeability, they can be used in quite steep applications. In use, both can also be operated in a minimum back height of 2.44 m (96 in.), while the StopeMate is small enough to fit through a 1.27 x 1.9-m (50 x 75-in.) opening.

Designed for bulk mining, the StopeMaster is capable of drilling 64- to 106-mm holes measuring up to 35 m deep while the smaller, more compact StopeMate can fit into a lift cage and drill 51- to 76-mm diameter holes at depths of 12-15 m. Both drills are offered in standard and HX versions. The StopeMate HX features an added hydraulic positioner, and the StopeMaster

HX features the same positioner as well as a self-propelled diesel option. The self-propelled version can disengage gears in order to facilitate towing where required.

Compact Machines for Narrow and Low Stopes

In January, Sandvik Mining announced an order for 83 machines for Royal Bafokeng Platinum's new Styldrift mine in South Africa. Scheduled for delivery during 2014, the equipment consists mainly of low-profile DD210-L drill rigs, LH208 LHDs, and the mechanized low-profile roofbolter, the DS210L-M. The company notes that the development contractor is also using DD210L drill rigs for this stage of the project.

The DD210L is a single-boom jumbo designed to work in stopes as low as 1.6 m. Despite having a carrier height of just 1.3 m, it is easy to operate and maintain as well as having a large boom coverage, Sandvik says. An HLX5 hydraulic drill handles hole sizes from 43 to 64 mm (1¹¹/₁₆-2¹/₂ in.)

Meanwhile, the Sandvik DD210-V is a compact narrow-vein single-boom electro-hydraulic drill rig designed for drilling in sections as narrow as 3.2 m (10 ft. 6 in.). It can be used for development, bolting and/or production drilling. Just 1.2 m wide and 1.85 m high with the canopy down for transport, it has a multi-purpose boom that give up to 27 m² of face coverage. A double rotation device allows the operator to position the drill feed vertically on both sides and close to the side walls.

For production drilling in small drifts, Sandvik offers its DL210 rig. Compact and flexible, this is suitable for various drilling applications, the company notes, being capable of drilling 51- to 64-mm (2- to 2¹/₂-in.) holes up to 20 m long. Its sister machine, the DL230, extends this range to

23 m (75 ft), being equipped with a boom that can drill parallel up- or down-holes and has a cable remote-control system for greater operator safety.

When it comes to loading out from narrow spaces, Sandvik's smallest diesel-engined LHD is the 0.7-yd³-capacity (1-mt-payload) LH201. Powered by a 33 kW (45 hp) Deutz engine, the machine has hydrostatic four-wheel drive. Its 3.65 mt operating weight means it is simpler to take underground than larger machines, while its length (4.6 m) and width (1.1 m) allow access to very narrow stopes and drifts.

Also suitable for narrow-vein applications, the slightly larger LH203 has the best payload-to-own weight ratio in its class, Sandvik claims. With bucket options of between 2 and 2.3 yd³, and up to 3.5 mt payload, the machine's unique bucket-filling system means that it has an excellent bucket fill factor, Sandvik adds, while its low weight helps increase tire life and cut fuel consumption.

Transferring Demolition Technology

The Swedish manufacturer of compact demolition equipment, Brokk, recently introduced its new model 100 as the successor to one of its most widely used machines. Although designed for use in construction demolition where access space is restricted, the machine can also be adapted for use in narrow-vein mining underground, the company said.

Weighing just 990 kg (2,200 lb) and capable of fitting through a 780-mm (31-in.)-wide opening, the Brokk 100 has a boom that can be equipped with a range of accessories. While its standard tool in demolition mode is a hydraulic breaker, such as Atlas Copco's 55-kg SB152, it can also carry a rock drill or a bucket for muck-



Sandvik designed the skid-steer DS110L bolting rig for operation in stope heights as low as 1.1 m.

ing out headings. The maximum weight attachment is 150 kg (330 lb), according to Brokk—light in terms of other drilling or mucking systems, but still effective in situations where narrow headings are needed to minimize dilution. There is also the potential for using a breaker, not only for scaling, but also for selective mining, especially where high-grade ore is held in very narrow zones.

Brokk notes that although the 100 has good reach and power, it folds into a surprisingly compact package, and can be transported in a small truck or trailer. It is also small enough to fit into most mine cages, with only a power supply needed for it to be put to work. Brokk's range now encompasses eight models, all of which are crawler-mounted, have a three-section articulated boom and are remote controlled for operator safety.

Specialized LHDs

The German company, Hermann Paus Maschinenfabrik, reports that it can provide individual solutions developed specifically for the demands of mining, with its PFL series of LHDs having been used successfully in operations worldwide for many years. The range includes small LHDs for narrow-vein operations, which are also designed for use at high altitudes.

The smaller and narrower the gallery, the smaller a machine needs to be in order to stay maneuverable, Paus said, although there still has to be enough room for components and, of course, the operator. The company added that it takes a lot of experience to address these challenges without making too many compromises. Since there are standards to follow (which may be different for different markets), such as

safety and a minimum space for the operator, or exhaust gases that require after-treatment and produce additional heat, this becomes even more complicated.

However, with its PFL 8, Paus copes with all of these issues. With a 1.5-mt payload using a 0.8-m³ bucket, the PFL 8 is one of the smallest underground loaders worldwide, although it is built strong enough to withstand tough conditions with poor roadway conditions. Paus points out that even though it is small in size, its 40-kW Deutz diesel engine gives enough power to perform properly, with a maximum tramping speed of 11 km/h.

Paus is going to launch an electric-powered LHD for narrow-vein mining at the bauma 2013 trade fair in April—the PFL 12e. The company's general manager, Franz-Josef Paus, pointed out to *E&MJ* that electric LHDs will become increasingly common in narrow-vein operations, since they offer a number of advantages over diesel engines. Ventilation requirements is one factor, with electric LHDs being a real alternative where the tramping distance is less than 200 m. In addition, he said, maintenance costs are up to 20% lower than for diesel-powered LHDs, with electric LHDs being more cost-efficient in life-cycle terms than their diesel counterparts.

The 40-kW, hydrostatic-drive PFL 12e is equipped with a 120-m-capacity cable drum. With a 1.2-m³ bucket capacity, its payload is 2 mt, while it has a maximum tram speed of 12 km/h.

Paus states that both of these machines are maneuverable and compact, but with good operator comfort. All the controls are arranged clearly and are within close reach of the operator's seat. Control is via two joysticks: one for the driving direction and

gear shifting, and the other for the boom hydraulics. Both air- and water-cooled Tier 3-complaint engines are available, as are different bucket types, including a side-dump bucket, with optional quick-coupling hydraulics that allow various attachments to be interchanged in minutes.

Canadian-designed Drills and LHDs

Within its product range, Ontario-based Mining Technologies International (MTI) supplies development and production jumbos, LHDs and mine trucks that are suitable for use in narrow-vein operations.

The company's eight-model LHD range includes four diesel-engined machines that have capacities of less than 2.5 yd³ (1.9 m³), equivalent to payloads of between 700 kg and 3.6 mt. The LT-70 is the smallest, with a 0.5-yd³ bucket and a hydrostatic powertrain. MTI claims that the operator cab fitted to the LT-70 is the largest in this class of machine, while the long wheelbase gives better stability in rough underfoot conditions.

The company's other small LHDs include the LT-210, LT-270 and LT-350, which carry 1–1.25-yd³, 1.5-yd³ and 2.5-yd³ buckets respectively, with payloads of 2 mt, 2.7 mt and 3.6 mt. All of these feature a mechanical powertrain.

In terms of longer-distance haulage, MTI also has an eight-model mine truck portfolio, of which the DT-704 and DT-1604 would be best equipped for working in constrained areas. The DT-704 has a 6.3-mt payload in a 3.3-m³ (4.3-yd³) body, while the larger DT-1604 carries 14.5 mt and has an 8-m³ (10.5-yd³) body. The company can also supply low-profile and ejector-type dump bodies for use in restricted-height applications. All of its mine trucks are four-



While the PFL 8 is one of the smallest LHDs available today, it is built to withstand the rigors of narrow-vein operations.



Introduced in 2011, Atlas Copco's Boomer M1 L drill rig is designed for use in low- to-medium-height operations. Its articulated carrier simplifies tramping in narrow headings.

wheel-drive, with an all-mechanical power-train and load-sensing hydraulics.

Turning to drills, MTI's Vein Runner II single-boom hydraulic rig is designed for drilling vertical, horizontal and angled holes in underground production headings. Equipped with a single hydraulic percussion drifter, it can be used to drill headings up to 5.5 x 5.1 m in size (18 ft by 16 ft 9 in.). Both Cummins and Deutz engines are available for moving the rig, which has a 107-m (250 ft)-capacity cable reel for the drilling power supply.

With an overall length of 10.7 m (35 ft 3 in.), the Vein Runner has an inside turning radius of 3.1 m (10 ft). Two boom options are available, giving different face-coverage possibilities, as well as three different feed lengths. The company uses Montabert hydraulic drifters on its machines.

Innovations Ahead

E&MJ asked Atlas Copco's product manager for face-drilling equipment, Peter Bray, for his views on some aspects of equipment that is suitable for narrow-vein applications. "Narrow-vein mining can be divided into two main areas," vertical/close to vertical and horizontal/close to horizontal ore deposits," he responded. "Both areas require equipment models that can physically operate in the drive sizes.

"To meet this need for small size equipment, Atlas Copco has a range of face drilling, long-hole drilling, bolting and

loading and haulage equipment suitable for both types of orebody," Bray said. "For the vertical type, some of the key machines are the Boomer T1 D face drill and Scooptram ST2 G loader, while for horizontal-type ore bodies, key machines include the Boomer M1 L, Scooptram ST7 LP loader and Minetruck MT2010 LP truck."

The company launched the Boomer T1 D in 2010 as a replacement for the Boomer 104, which had been in production since the 1990s. Key features upgraded on the T1 D included a stronger frame with a lower center of gravity, a more powerful engine, an improved boom-suspension system to reduce stress on the machine, a more ergonomic operator's cab and improved serviceability.

The single boom is designed to carry Atlas Copco's COP 1638, COP 1838 or COP 2238 hydraulic rock drills, with a hydraulically controlled drilling system that incorporates the company's Rotation Pressure Controlled Feed (RPCF) anti-jamming function. The on-board compressor supplies 11.7 liter/s (25 cfm) at 7 bar (100 psi).

The Boomer M1 L, meanwhile, also carries either the COP 1638 or COP 1838 drills, but can operate in a minimum tramping height of 2.2 m (7 ft 3 in.). The machine uses the same compressor as the Boomer T1 D, with both rigs using hydrostatic steering and transmission systems.

Asked how the technologies used have developed—given that narrow-vein opera-

tions are often run by companies with less-extensive capital budgets—Bray noted that recent developments have focused on increasing productivity through the mechanization of equipment functions, and on improving the ruggedness of machines to meet the often challenging conditions encountered in narrow-vein mines. "What is important to remember, is that the capital cost of equipment is only one aspect of the total cost of ownership for a machine. Mines often forget to look beyond the purchase price, and may overlook equipment alternatives that could greatly benefit their operation," he said.

Looking ahead, Bray suggested that technologies transferred from tunneling, such as electronic drill plans coupled with semi/full automation, have great potential to improve efficiencies and reduce wastage in narrow-vein mining. These systems can help reduce overbreak, the drill meters needed and the amount of explosives required, give improved fragmentation that simplifies loading and haulage, and generally cut drilling and mucking costs, he said.

Where loading and hauling is concerned, there is great potential to make use of intelligent vehicle-operating systems that can cut fuel and tire consumption and increase productivity, with automation, object detection and steering assistance being just some of the areas that could benefit narrow vein and other mining operations, he added.

New Drill Rig Models Roll to Market

Over the past six months or so, several well-known drill-rig manufacturers have released new or upgraded models to fill gaps in their product lines, comply with applicable safety codes or tailor model configurations and capabilities to specific markets.

Boart Longyear, for example, recently introduced its newest surface exploration rig, the LX11, as an economical multipurpose unit that offers improved safety features, track propulsion, a smaller footprint, and overall lower cost of ownership. The mid-sized LX11 joins an existing line of multipurpose rigs that includes the LX6 and the LX16. Capable of drilling in both reverse circulation (RC) and diamond core modes, the LX11 allows exploration drillers to use just one drill rig when working in variable ground conditions.

The LX11 can reach depths of 1,450 m (4,750 ft) using NQ rods for core drilling and 325 m (1,065 ft) using 114-mm (4.5-in.) rods for RC drilling. A 7.2-m (23.6-ft) mast and a top drive head allow 6-m (13-ft) rods to be pulled under the head for increased productivity. A top drive single rotary drill head provides up to

1,200 rpm rotation and maximum torque of 7.8 kNm (5,800 ft-lb) at 100 rpm.

Safety features incorporated into the LX11 include a strategically placed control panel for operator visibility, a remote control for maneuvering the rig safely from a distance and an interlocked safety cage to protect drillers from the rotating drill string. The LX11 can be equipped with a rod handler for both RC and diamond coring rods.

The small footprint of the LX11 allows for easier site access and maneuverability. It is designed to be shippable in a 12-m (40-ft) container, making it economical to deploy to remote locations.

Enhanced safety features, as well as technical updates, also have been designed into two exploration rigs recently unveiled by **Sandvik**: the DE712, which is the latest in the company's line of DE700 series surface exploration drills; and the DE130x.

The DE712 is based on the existing DE710 rig, and retains popular features offered by that model, including:

- Depth capacity of 1,126 m (3,693 ft);
- Pull force of 9.3 mt and feed force of 5.5 mt;
- Continuous torque rating of 475 Nm (350 lb-ft) at 1,500 rpm; and
- Compact design allowing it to fit in a standard 40-ft container.

Key upgrades in the DE712 include:

- European Union CE certification;
- ROPS certified operator compartment (roll-over protective structure);
- Hydraulically operated left- and right-hand walkways; and
- EU Stage III CARB / EPA Tier 3 diesel.

Additional safety features built into the DDE712 include lever guards to reduce risk of accidental operation, a mast access package that provides a fall-arrest system and mast platform, and an alarm for jack leg operation. Rig access has been improved for easier maintenance and extra guards have been fitted for safer work environment.

The DE712 features a more powerful engine, rated at 142 kW (190 hp) at 2,200 rpm. Sturdy hydraulic pumps and motors in independent open loop circuits, along with larger hydraulic valves and piping, provide higher energy efficiency and precise control of critical drilling functions.



Sandvik's DE712.

The new DE130x is a fully certified exploration drill rig for underground coal applications and is compliant with current ATEX standards. Its design is based on Sandvik's popular DE130 core drill. According to the company, its modular layout, depth capacity of 815 m (2,674 ft) N-size rod capacity, feed force of 4.7 mt and pull force of 6.3 mt, makes the DE130x a highly capable rig. Additional features include an extra gauge for rod holder surveillance on the control panel and a wire emergency stop on the feed boom for increased safety.

New Production Rigs

At bauma China 2012, Sandvik introduced the DH350 down-the-hole (DTH) surface rig, described as "the right choice" for those seeking an economical, simplified-to-use and reliable drill. The DH350 is diesel-powered and track-mounted, designed to use 3-, 4- and 5-in. (75-, 100- and 125-mm) DTH hammers for hole diameters ranging from 89–152 mm (3.5–6-in.).

The 7,300-kg (16,000-lb) DH350 features a rigid fixed boom and feed design and efficient hydraulics for boom positioning, feed, rotation, tramming and track oscillation. Operational productivity, hole accuracy and drilling smoothness are enhanced by a heavy-duty rotary head rated at 2,530 Nm torque. The rig is equipped with a 43-kW diesel for drilling and ancillary power; to reduce fuel costs,



Boart Longyear's LX11 exploration drill.



Sandvik's DH350 DTH rig.

it depends on an external compressor powered by an independent engine to provide air for the hammer and hole flushing.

Drilling functions are centralized in a single control panel, and a separate tramming control station is located at the rear of the rig, along with an operator transport platform. Daily service points are within easy reach from the ground level.

According to Sandvik, the DH350 initially will be offered only for the Chinese market.

Atlas Copco's latest rotary surface drill, the Pit Viper 311, was unveiled at MINExpo 2012 and is the first model in an all-new Pit Viper 310 series. The 311 can be configured to drill to 65 ft (19.8 m) in a single pass or to a maximum depth of 125 ft (38.1 m) in two passes.

Atlas Copco said the PV-311 offers a narrow hole-diameter range of 9 to 12.25 in. (228 to 311 mm), to fill a gap between the hole ranges offered by its Pit Viper 351 and Pit Viper 270.

The Pit Viper 311 offers power options that include Tier 4 and Tier 2 diesel engine alternatives. The tower has an interchangeable unit, structurally similar to the Pit Viper 351, but is deeper to accommodate larger sheaves for either single-pass or multi-pass applications. Weldments have been improved, and a ladder now provides access to decking above the rod changer when the tower is horizontal.

The two-speed hydraulic rotary head delivers 12,880 ft-lb (17,500 Nm) of rotation torque at 140 rpm and 7,000 ft-lb at 240 rpm. Hydraulic cylinders drive the cable feed system, and the patented automatic cable tensioning system reduces cable and rotary head guide wear by continually keeping the rotary head aligned.

Standard across the Pit Viper range, including the Pit Viper 311, are a hydraulically powered breakout slide wrench and a hands-free auxiliary hydraulic wrench with a 6-in. clamp cylinder. The fork chuck features an improved deck bushing.

Atlas Copco offers a number of options for the Pit Viper 311, including a new automatic hydraulic clutch designed to decrease fuel consumption during non-drilling operations. In addition to standard safety and interlock features, the unit's Rig Control System supports auto-level, auto-drilling, GPS hole navigation, wireless remote tramming, and more.

At MINExpo, the company also noted that the Pit Viper 316—an extended multi-pass version of the Pit Viper 311—was under development, and when available will be capable of drilling to 295 ft (90 m) using a five-rod carousel with 50-ft drill pipe. The Pit Viper 316 is scheduled to be launched during 2013 as a replacement to the DM-M3 model and is designed specifically for cast-blasting applications in coal mining.

Rig Upgrades

Last month, Atlas Copco also announced that installation and testing had been completed at its factory in Örebro, Sweden, for the first system integration of **Carlson Machine Control's** CBx5 control box console running Carlson DrillGrade software on a FlexiROC HEC3 C65 drilling system.

This, according to Atlas Copco and Carlson, marks the first successful factory installation of a 3-D drilling system integrating Atlas Copco's new third party protocol available on FlexiROC drills with the HEC3 system.

In addition to providing support for most GPS/GNSS receivers, this system allows users to:

- Navigate and position from within the drill cab without need of target marking;
- Create a drill pattern in the machine to a terrain model, depth and height;
- Load/change terrain models and localizations easily;
- Import DWG, DXF, CSV and IREDES hole data;
- Visualize 3-D surfaces in the field on a large, bright screen; and
- Monitor FlexiROC with HEC3 drill actions such as body pitch and roll, heading, length of current hole, current position of drill bit, drilling stopped,

drilling started, drilling aborted, reset hole length and more.

An upgrade kit, which consists of the CBx5 Control Box Console, Carlson DrillGrade software, MC Pro Vx5 RTK Heading Unit, brackets and required cables, will be available soon for qualified, existing FlexiROC with HEC3 system drills. Atlas Copco must qualify the FlexiROC with HEC3 version and provide the protocol. A similar retrofit kit is also available for existing qualifying SmartROC RSP system drills.

And, exploration drill manufacturer **Schramm** announced that a new hands-free Power Breakout is now available for its T450 and T685 series exploration drill rigs. This system improves pipe handling safety by reducing an operator's physical contact with drill pipe during operations, and also speeds connections by eliminating the manual tongs typically used when tripping into and out of the borehole.

Used in conjunction with the hydraulic holding fork; the hydraulic Power Breakout slides out to align with the tool joints, clamps on the upper connection and then rotates to break the tool joints. Once broken, the jaws are released and reset to the break-ready position and the assembly is retracted back into the mast. This system is designed to work with drill pipe ranging from 3 to 5-1/2 in. (76 to 140 mm) OD pipe and can provide breakout torque up to 16,000 ft-lb (21,693 Nm).



Atlas Copco Pit Viper 311.