



Top gear

Technology to improve mining productivity

LEN EROS, MIKE SMALE, DAVID KEECH – High demand for basic raw materials has put pressure on the mining industry and created a trend toward larger mining operations with higher productivity targets. However, how do these huge mining operations produce more – under challenging environmental conditions – while at the same time containing costs? One way is to partner with a company that can offer not only engineering expertise but also robust, innovative equipment engineered for mining's unique production needs. On the equipment side, ABB has a broad range of field-proven products that are used in conveyor belts, hoists, crushers, mobile haulage machines, ventilation fans, etc. Many of these require gearing and it is essential to have the very best gear-reducing products if cost, maintenance and production targets are to be achieved.



Technological developments have made it possible to mine ores of declining grades and more complex mineralogy while minimizing cost increases.

The global mining industry is huge: By the end of 2012, there was over \$400 billion of investment in capital programs outstanding [1]. And keen competition makes mining productivity very important. Most productivity increases in the past century have been achieved through more efficient mineral processing and the use of larger-scale equipment. Thus, technological developments have made it possible to mine ores of declining grades and more complex mineralogy while minimizing cost increases.

Today, companies such as ABB that can deliver complete technical solutions to the mining industry have an advantage due to the necessity to competently ad-

dress the sheer scale and complexity of modern processes producing material at ever-faster rates.

ABB has not only industry expertise but also a broad range of field-proven products that live up to the specific performance and efficiency requirements of mining operations. ABB's products are used in equipment such as conveyor belts, hoists, crushers and ventilation fans, as well as mobile haulage machines and systems. Because of the harsh and demanding nature of mining processes, robustness and reliability are key product requirements.

Power savings have an impact on mining companies' bottom line, too, so energy-efficient products hold an important

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advantage. More broadly, mining companies benefit greatly from a partnership that can supply a total electrical and mechanical solution.

Products giving lower total cost of ownership

ABB's portfolio of electrical products includes a full range of motors, including

Title picture

To keep at the forefront of large-scale, intensive mining, modern mining enterprises form tight collaborations with engineering partners who have not only expertise, but also a comprehensive range of products suitable for the tough conditions encountered in excavation operations.

Power savings have an impact on mining companies' bottom line, so energy-efficient products hold an important advantage.

1 Fully assembled drive system package featuring a 2,500 K Dodge CST, a 2,500 hp Baldor Reliance motor, an optional 3,150 pound fly-wheel and high- and low-speed couplings



explosion-proof mining duty motors, and low- and medium-voltage variable-speed drives (VSDs) of many types. ABB's mechanical portfolio encompasses large gearing, controlled-start transmissions, mounted bearings, couplings and pulleys. Offerings also include power distribution and power conditioning systems and switchgear to direct electrical energy to the mining equipment.

ABB offers the most complete line of large AC and mining industry motors in the world. Baldor-Reliance® stock and custom motors are available up to 11 MW (15,000 hp), while induction and synchronous motors are available up to 65 MW (87,000 hp). This offering includes both NEMA (National Electrical Manufacturers Association) and IEC (International Electrotechnical Commission) configurations, which reassures customers they will get a motor that meets frame, enclosure and duty cycle standards for specific applications. Min-

along with bearings and sealing systems that extend life.

ABB also delivers the latest in conveyor drive technology in the form of gearless conveyor drive systems. These utilize low-speed synchronous motors with frequency converters and reduce the overall component count, thus increasing system reliability and reducing maintenance requirements.

Gear reducers

In conventional geared drive systems, motor power can be delivered to the conveyor system with ABB's various proprietary gear reducers, including the controlled start transmission (CST) and MagnaGear XTR® reducer, both specifically designed for mining applications.

Dodge® CST

The Dodge CST is designed to provide motor load sharing to minimize the loads and stresses on all conveyor components.

In essence, CST is a two-in-one gearbox that combines a planetary gear reducer with an integral wet clutch system. When coupled to an AC induction motor, the CST gearbox

The Dodge CST is designed to deliver superior motor-load sharing to minimize the loads and stresses on all conveyor components.

ing industry motors are designed with an extra-tough external construction to suit the rough operating environment,

converts the motor's high-speed, low-torque input to a low-speed, high-torque output. Torque ratings up to

2 A 210K MagnaGear XTR operating on a 365 m long conveyor with a 26 m lift



The largest installed base is in China, with more than 2,000 CSTs in operation.

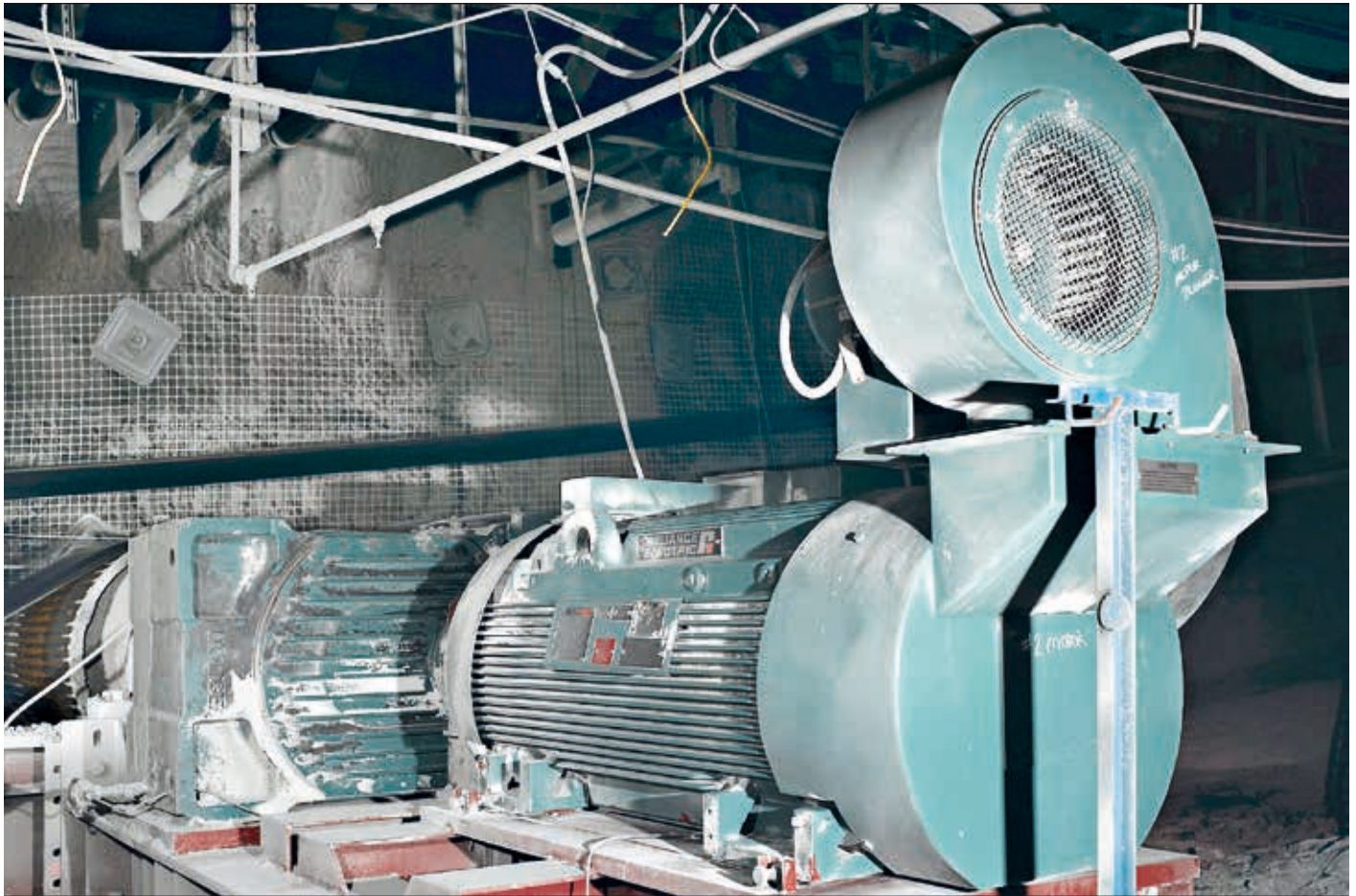
400 kNm (3,500,000 lbf in) are available. Maximum motor power is available throughout the full operating range. The clutch unit absorbs shock loads and protects the motor, gearbox, bearings, pulleys, conveyor belts and splices. The rugged design delivers total control of the most difficult high-inertia loads, such as long conveyor belts and conveyors with multiple synchronized drives → 1.

The wet clutch system, located internally on the output side of the gearbox, allows the motor to be started under no-load conditions. As the PLC-based control system gradually engages the clutch, the output shaft begins to rotate and smoothly accelerates to the desired driving speed in a predetermined time.

Serviceability is also a key factor in drive system selection. CST systems are simple to operate and maintain without

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the high degree of technical expertise required by more complex control packages. This is especially important in remote locations that rely on local resources for service and maintenance.



By 2012, more than 3,000 CSTs were installed worldwide, and there are six cur-

rently being installed in a copper mine in South America – one of the most complex installations of its type. At an elevation of 5,000 m, it will include four 2,250 kW (3,000 hp) CSTs and two 1,400 kW (1,900 hp) CSTs, with bases and high-speed brakes.

The Dodge MagnaGear XTR is an innovative speed reducer widely used for heavy duty applications requiring torque ratings up to 240 kNm.

For another customer, ABB provided a design that offered 20 percent savings on the capital cost of the drive, with additional savings on the installed cost of the conveyor system. It was substantially lower in cost than the specified design, but delivered more total power. Using

three 1,875 kW (2,500 hp) drives, with nearly 3.7 km of loaded belt, this mine has produced as much as 100 million tons of coal annually.

The largest installed base is in China, with more than 2,000 CSTs in operation. One company has 400 CSTs that are used

across 17 coal mines with a total area of 10,000 km². Equipped with sophisticated remote monitoring, this system has achieved an availability rate of 98 percent.

Dodge MagnaGear XTR

The Dodge MagnaGear XTR is another innovative speed reducer widely used for heavy-duty applications requiring torque ratings of up to 240 kNm (2,100,000 lbf in) → 2-3. In sizes over 44 kNm (390,000 lbf in) it incorporates a planetary gear design, which is a compact, durable and economical solution for high-torque applications. MagnaGear

XTR reducers can be used with a wide variety of softstart and control systems, including electronic softstarts, VSDs and fluid couplings.

MagnaGear XTR reducers are designed to meet or exceed AGMA (American Gear Manufacturers Association) minimum bearing life. The bearing life, in fact, is more than double that found in many competitors' reducers. Incorporated in this design is a tandem sealing arrangement and efficient cooling system that offer low-maintenance operation. MagnaGear has an associated line of accessories tailored to particular applications, including baseplates, swing-base mounts, tunnel drive configurations, torque arms, internal lift-off style backstops, couplings and electric fans.

Dodge mounted bearings set the standard in the industry. The ISAF and metric ISN types offer the only push/pull adapter mount system that cuts installation time, while the fully concentric shaft attachment virtually eliminates fretting corrosion. A Dodge large-bore pillow block bearing for larger applications features a patented hydraulics-assisted, adapter-mounted installation and removal system. Not only are these bearings quickly installed and removed, they are factory assembled, sealed and lubricated. ABB's mechanical power transmission offering is completed by engineered pulleys and a variety of couplings.

More than products

As engineering expertise within mining companies is often constrained, they often partner with manufacturers that can not only offer appropriate products, but also engineering expertise. ABB mining experts, along with Baldor's mining industry team, understand the challenges the industry faces and know the best ways to apply products and packages to deliver successful solutions.

The design of conveyor drive systems is a good example of the joint approach. The goal here is to design a conveyor that transports as much material as possible with best performance and reliability. The challenges are formidable: The trend in the industry is to use conveyors to transport bigger loads over longer distances. A conveyor may have to transport as much as 30,000 tons of material per hour over distances of 10 to 20 km,

24 hours a day. Early in the design process, the team uses an industry standard program ("Belt Analyst") to configure the drive system with the correct output power and optimize the selection of motors, VSDs, gearing, bearings, couplings and pulleys.

ABB stays at the forefront of mining technology by collaborating with a number of universities and industry bodies around the world. Research projects have covered the modeling of next-generation motors and issues such as heat transfer and the cooling of motors. In relation to standards development, the company has members on various NEMA, IEC, IEEE and CEMA (Conveyors Equipment Manufacturers Association) technical committees.

With such an all-encompassing range of products and such extensive industry experience, ABB can solve customer problems by delivering power-matched solutions with the right motor, control system, gearing, bearings, couplings and pulleys. ABB will continue to identify and develop industry-specific application solutions to deliver benefits to end users with the aim of reducing total cost of ownership through longer operational life and improved reliability combined with reduced downtime, higher operating efficiencies and energy cost savings.

MagnaGear XTR reducers can be used with a wide variety of soft-start and control systems, including electronic soft-starts, VSDs and fluid couplings.

Len Eros

ABB Motors and Generators
Littleton, CO, United States
len.eros@us.abb.com

David Keech

Mike Smale

Baldor – a member of the ABB Group
Greenville, SC, United States
david.keech@baldor.abb.com
mike.smale@baldor.abb.com

Reference

- [1] "Trends in the Mining & Metals Industry: Mining's Contribution to Sustainable Development," International Council on Mining & Metals. Oct. 2012.