

Upgraded Haulers Sell in OZ, Elsewhere

The latest reported advances speak to improving cycle times, better battery technologies, and creating a safer work environment

By Jesse Morton, Technical Writer



An LHD dumps its load in a new Sandvik TH663i truck.

Being a MINExpo year, disruption is in the cards for the underground haulage equipment space. Until the event in Las Vegas this fall, suppliers are keeping their hands close to their vest. Company insiders told *E&MJ* Sandvik is gaining market share in Australia, Aramine is perfecting its miniLoader, and Komatsu is fielding interest in a couple powerful Joy loaders.

Insiders at companies with impending big releases provided only summaries. Artisan Vehicle Systems, now a subsidiary of Sandvik, will announce a new machine at MINExpo. RDH-Scharf reported it will release a new machine later this spring.

In every case, the technological advances inherent to the machines making the news center on improving production rates, better battery technology, and meaningful contributions to work site safety. A summary of the latest news from the top suppliers illustrates.

New Transmissions, Better Cycle Time

Sandvik reported the first orders for TH551i and TH663i trucks that come standard with the new transmissions announced in December were placed by customers in Australia. "Based on the

feedback we received at the Digitalization in Mining event in Brisbane, our customers are really looking forward to these trucks," Pia Sundberg, product line manager, trucks, Sandvik Mining and Rock Technology, said. "We are expecting a global fleet within a year."

The new transmissions are the latest updates to the trucks, and are the result of years of research and development driven largely by customer feedback. "They wanted to reduce the costs of ownership, increase uptime and improve operator comfort," Sundberg said.

Sandvik and a supplier put "thousands of hours" into the development project, which culminated with trials at mine sites in Finland, Ireland and Australia, she said. "Different duty cycles were tested, both driving the truck uphill fully loaded, which represents the typical cycle, but also driving fully loaded downhill, which is used in some mines where backfilling is done."

Company literature states the main benefits of the new eight-gear transmission include improved truck performance, availability, and transmission lifetime.

It improves truck performance by enabling maximum truck speed and effi-

ciency in varying ramps and with differing loads. "The fully proportional, more powerful hydraulic retarder operates simultaneously with the engine brake, enabling easier downhill control and higher speed," Sandvik reported. "Further lock-up to lock-up gear shifting enables quick and smooth shifting and keeps speed better while driving uphill."

Sundberg said one possible result is shorter cycle times.

With a robust, simple and application-specific design, the new transmissions offer improved reliability over the old ones, the company reported. "Compared to the previous six-gear model, the transmission lifetime is expected to be longer, and less gearbox changeouts are required during the truck lifetime, reducing costs."

Improved reliability can translate to increased availability, Sundberg said.

The transmission control system features improved self-diagnostics capabilities that are fully integrated into the Sandvik Intelligent Control System, "enabling easy and fast trouble shooting without external diagnostic tools or laptops," Sandvik reported.

Sundberg said such is a "fine example" of how Sandvik seeks to marry the "robust and reliable" to "today's technology" to ensure dependability. "Safer, stronger, smarter, as we say."

In trials, operators noted the easy operation and extremely smooth gear shifting, she said.

"It makes the ride much more comfortable," Sundberg said. "If we add this new extra value to the already ergonomic TH551i and TH663i cabin, what we like to call the industry-leading cabin, it is really nice for the operator."

The smooth ride can increase operator wellbeing, she said. "We have got really positive feedback specifically on how smooth the new transmission is, and how comfortable our TH551i and TH663i cabins are," she added.

The new transmissions speak to the needs of mines running deeper and need-

ing to move increasing amounts of rock. "As ore bodies close to the surface are becoming depleted, mining is going deeper and getting hotter, and truck haulage to the surface needs to be more efficient," Sundberg said. "Long ramp drives, be it either up the ramp or down the ramp, require a lot from the technology."

Also, the longer life of the new transmissions aligns with sustainability efforts at many mines, Sundberg said. "Longer component lifetimes mean that less component changeouts are required, and also the truck stand-still time is reduced," she said. "This again can be turned to lower costs per metric ton (mt) hauled, linking nicely the sustainability and cost benefits."

The new transmissions can be bought separately and installed on existing trucks. "The transmission change is typically done at the same time as the midlife repair, which is around 12,000 to 14,000 hours, depending on the equipment usage and the exact components," Sundberg said. "The transmission conversion kits will be made available in mid-2020."

To get the full benefits, the axles and coolers should be upgraded at the same time that the transmission is replaced.

The new cooler performance has been optimized to match specifically with the new transmission, Sundberg said. "The coolers are made of aluminum, are easy to clean and have simpler design, helping to reduce total cost of ownership."

Since their release shortly after MINExpo 2012, both trucks have been upgraded a couple of times.

Announced in Las Vegas and released in 2013 in Europe, the TH663 was upgraded in 2015 with a sintered metal diesel particulate filter, which reduces diesel particulate emissions by 99% and can be cleaned with a steam cleaner. The following year it was offered with a 565-kW Volvo Penta D16 engine, which offered longer life and lower fuel consumption, and required fewer consumables.

"We have continuously worked to improve the engine and powertrain technology in our trucks," Sundberg said.

Along with the TH551, which was originally released in 2013 with a Tier 4 engine, in 2017 the TH663 was offered AutoMine-ready.

"With AutoMine Trucking, the TH551i and TH663i can be used for autonomous haulage for both transfer level and decline ramp applications," Sund-

berg said. "When used on automation, the trucks can be operated from the surface during blast clearance and shift changes, increasing safety, truck utilization and productivity."

The evolution of both trucks was steered by Sandvik to ensure measurable gains in offered productivity and efficiency, she said. "The trucks are rugged and made for heavy-duty use and demanding ramp applications. And they are smart, too," Sundberg said. "Our Sandvik Intelligent Control System allows us to build impressive solutions for digitalization and connectivity needs."

Customer feedback suggested the trucks offer optimal operator comfort. "The ride is smooth thanks to the front frame suspension; there is air conditioning, noise and vibration reduction, adjustment possibilities in the seat and more," Sundberg said. "I personally believe the best feedback for me was when I heard that 'the operators just loved it,' or, from another mine, 'it was the operator's No. 1 choice.' Operator safety and comfort is a top priority at Sandvik."

miniLoader Adds Optionality

Aramine reported a mobile charging station for the miniLoader L140B will be released later this year. The station is equipped with a hydraulic crane for streamlined battery changeouts for the LHD, and for moving the battery nodules.

Connected to a mine's electrical network, the station can be easily piloted by remote control, the company reported.

Arnaud Paul, sales director at Aramine, told *E&MJ* that the new system will make changeouts easier and safer, and thus help improve productivity at an operation.

The crane was developed based on demand and feedback from customers, Marc Melkonian, president, Aramine, said. "The mobile charging station solves all customer concerns about the autonomy and ease of replacing batteries on the LHD," he said.

The mobile station will provide charging and changeout scenario optionality beyond the currently available methods.

One current method is to simply plug the loader in and let it sit.

The L140B was "entirely designed and developed around a fully integrated battery system," Sylvain Reynier, research and development director, Aramine, said. "Our R&D department worked hard to reorganize all components inside the machine and select an extremely reliable and safe connecting system."

This allows the machine to, whenever needed, be plugged into a wall socket anywhere in the mine. "The charging system doesn't need a big electrical installation as the power needed is about 7 kVA, compared to the 45 kVA needed for a cable-tethered electrical machine," Reynier said.



Aramine's mobile charging station for the miniLoader L140B is equipped with a hydraulic crane.

"The regeneration system will also recharge batteries when the loader goes downhill and when it brakes," he said.

A full recharge from a wall socket could take from two to five hours. "The autonomy is approximately three to four hours depending on application and usage, which allows mucking three to four faces before recharging," Melkonian said.

Another current method is the optional Quick Replacement System (QRS). For that, batteries are charged external to the machine and then swapped out as needed. Such "allows running the machine full time without immobilization during charging time," Aramine reported. "The system is ultra-fast and smart with a W-type aligning system and an auto-locking device." The device ensures optimal safety, the company reported.

"The R&D Department ran a lot of tests to find the perfect angle of adherence in the W-type system and to find the faultless self-aligning mechanism," Melkonian said. One result is "QRS features a quick, reliable and compact battery module with an auto-lock system without increasing the length of the machine."

To adopt QRS, the mine must have a battery change area and crane. "The battery change is stress-free, does not require a lot of equipment, and can be done quickly," Reynier said. "Indeed, it takes about 10 to 15 minutes and effectively allows unlimited operation of the machine."

QRS is ideal for a miner seeking to operate only one machine. The system is available for adoption as an aftermarket kit.

QRS is the latest innovation for a loader model that has evolved over the years apace with advances in emission-reduc-

tion, sustainability, and connectivity solutions, all of which contribute to improved worksite conditions and safety.

"We all know that one of the biggest issues in underground mining is the air pollution," said Sophie Layer, marketing and communications director, Aramine.

Previous generations of the loader were designed to address this issue. Roughly a decade ago, Aramine launched a diesel miniLoader with an exhaust purifier. Next, it released a cable-tethered electric unit. "That helped reduce mine ventilation issues and related costs," Layer said.

At the time, battery technology was prohibitively expensive and relatively unreliable. Battery technology advances over the years enabled the company to design the L140B, which spent two years in research and development.

Released in 2016, the loader comes standard with a LiFe PO4 (lithium iron phosphate) battery, a CAN-bus-type electrical system for diagnostics and programming, and "intuitive and ergonomic controls," the company reported.

"The lithium iron phosphate battery is the safest chemical composition for an underground mining battery vehicle," Reynier said.

Paul said the loaders are field proven. "With 20 units in operation, many with 10,000 hours on them, and with our rental equipment for tunneling applications, we can safely validate the efficiency and the reliability of our solution," he said.

For example, field results prove the loader effectively solved the air pollution issues related to the diesel predecessor model, Melkonian said. "This brings real

comfort for the driver and the people working around the machine," he said.

By "ensuring zero CO₂ and zero NOx emissions," it nixes some stubborn ventilation and safety issues and costs, Melkonian said. "By ensuring they can breathe safely at work, it brings miners peace of mind."

Plus, it "is easier to maintain compared to the diesel model," he said. "You have no combustion engine maintenance or air filter maintenance."

Also gone is the diesel fuel tank and filters, as well as the hydrostatic transmission. Instead, there is an integrated electrical transmission. "This eases the maintenance and considerably reduces the downtime," Melkonian said.

Compared to the cable-tethered electric model, the battery-powered unit offers greater freedom and safety by eliminating cable management protocol, he said. "The electrical installation needed to charge the battery is far less than that needed to drive the electric machine with cable."

The L140B has a very low heat signature and, compared to predecessor units, is quieter, "which is crucial in an environment as constraining as that of a mine," Layer said.

Equally crucial, the L140B has the same or greater breakout force than the diesel competition, Reynier said.

"People tend to think that battery-powered machines are less powerful than diesel ones," he said. "This is totally untrue. Aramine battery-powered machines use an electric transmission that allows adjusting the torque depending on the mine conditions to give just enough power while preventing tire spinning."

With tramping capacity of 1,300 kg, tilt breakout force of 32 kN and lift breakout force of 35 kN, it has a 0.7-m³ bucket and can move fully loaded at up to 7 km/h.

The loader is described as ideal for narrow vein mines. From tip to tip, it is 5.3 m long, 2 m high and 1 m wide. Company literature describes it as "extremely narrow."

It was developed for miners "who do not want to oversize their galleries," Melkonian said. It is also for those who want to "increase productivity and reduce dilution by using small and medium gallery sections."

The optionality offered by the new mobile charging system aligns with the company mission to be at the forefront of technological innovation that contributes to sustainable mining, Layer said.



The Joy SR Hybrid LHD's control algorithms optimize efficiencies in applying torque to the ground, controlling wheel slip, and reduces fuel burn.

On that mission, the company plans to release a new battery-powered machine in late 2020. More information on that, she said, will be forthcoming.

Speedy Joy LHDs See Demand

Komatsu reported the Joy 18HD and 22HD hybrid loaders are gaining market share thanks in part to cost savings made possible by two groundbreaking diesel-electric drive technologies.

Bill Maki, product manager for the loaders, told *E&MJ* the loaders leverage Switched Reluctance technology (SR) and the Kinetic Energy Storage System (KESS), which sync to cut fuel burn by up to 30%. The combo “also results in fewer diesel emissions, making for a cleaner environment.”

While the loaders are operating, the diesel engine runs at a constant speed for optimal performance. An SR generator mounted to the engine converts diesel to electricity, which powers the wheel motors.

When the operator eases off the accelerator, the demand for diesel stops. During deceleration, there is no need for the operator to use mechanical brakes as the electric drives inherent dynamic braking slows the machine.

And as the machine slows, the wheel motors act as power generators. The energy captured is stored by KESS.

When the loader is finished coasting, braking, digging or dumping, and when the operator “presses the pedal again, KESS supplies stored energy while the SR engine simultaneously supplies diesel energy,” Maki said. “The result is the equivalent of a 375-hp (280-kW) engine being bolstered by an additional 550 hp (410 kW).”

SR has been used for surface mining wheel loaders designed and built at Joy’s Longview, Texas, facility. Customer demand prompted the company to build the tech into LHDs.

LHD “speeds were much higher than they were with the surface loaders, and significant energy was available that we simply lost to heat,” Maki said. “Komatsu developed the KESS to capture and reuse this energy.”

The combo basically boosts acceleration without any additional fuel burn.

“The SR Hybrid LHD is suitable to all applications,” Maki said. “The biggest benefits occur when higher speeds are achieved.”

Related benefits include improved work cycle time, reduced operating cost, increased reliability, and reduced engine size, Komatsu reported.

“In current installations, Komatsu is seeing 15% to 20% less fuel consumption than its similar-sized competitors,” Maki said.

The loaders feature “advanced SR control algorithms to optimize efficiencies in applying torque to the ground, controlling wheel slip to minimize tire wear, and significantly reduce fuel burn,” he said. “We also have incorporated decades of mining duty traction motor design knowledge to ensure our motor and generator designs are rugged and reliable and up to the task of achieving long life in the tough mining environment.”

The 18HD is 11.6 m long, 3.2 m wide, and 3 m high, with a 7.3-m outside turning radius. With a 10.6-liter engine, it has a bucket capacity of 9.2 m³, tilt breakout force of 349 kN, and a payload capacity of 18,000 kg.

The 22HD is 11.7 m long, 3.7 m wide, and 3 m high, with a 7.5-m outside turning radius. With a 12.8-liter engine, it has a bucket capacity of 11.2 m³, tilt breakout force of 347 kN, and a payload capacity of 22,000 kg.

Both LHDs come with a U.S. Tier IV Final (EU Stage IV Final) engine, a ROPS/FOPS-certified cabin and a simple control suite featuring an “intuitive human-to-machine interface,” Komatsu reported.

Both have the LINC II (CAN-based) vehicle control system, which enables high-speed monitoring and advanced diagnostics, including integrated data capture and storage, the company reported. The system can provide real-time load data, cycle times, production rates and an operational profile. It can connect to a radio dispatch system for remote-monitoring purposes.

Maki said the control system monitors every aspect of the machine and protects it from potential problems. “The control system also provides feedback to the operator and technician to quickly diagnose any issue that may arise,” Maki said.

Which should be comparatively few, as the electric drive system has relatively fewer mechanical components, he said.

Offering significantly decreased diesel costs per ton moved, the loaders are fated to find a sizeable niche in the market, Maki said.

“It’s continued innovations like these that are powering progress for our custom-

ers worldwide and moving us forward,” he said. “Together, we will continue to revolutionize mining for a sustainable future.”

Battery-powered Hauler Tours Oz

Artisan Vehicle Systems (AVS) reported a battery-powered Z50 haul truck was recently showcased at a handful of mines in Australia. The tour launched in December in Queensland and included stops in New South Wales, South Australia and Western Australia.

Each stop involved demonstrations, training, and education on the benefits of battery-powered haulage machines underground, said Joe Giraldi, business development manager, AVS, Sandvik Mining and Rock Technology.

“The tour has been a true success and is creating a lot of buzz,” he said. “It will bring additional awareness to the fact that this technology is not only available today, but that it has been proven for almost a decade in the field. We deployed our first battery-equipped unit in 2011, and now have over 400,000 real production hours on our systems.”

Currently there are six Z50s in the field with orders pending.

Announced in 2018, the unit was the world’s first 40-mt battery-powered underground truck. It was readily adopted by Kirkland Lake Gold’s Macassa mine in Ontario.

In 2020, the Z50 was launched at the Sandvik Digitization Event in Brisbane, Australia. Since then, it was adopted by a mine in Nevada, Giraldi said.

At 35 ft long and 11 ft wide, the Z50 comes with both a primary and a tramming (lithium iron phosphate) battery, offers peak torque of roughly 6,200 foot-pounds and has a 50-mt-capacity bed. Company literature reports the unit “generates twice the peak horsepower” with a fraction of the heat of the diesel equivalent.

“Because these are zero diesel emission vehicles, we are not horsepower restrained,” Giraldi said. “Therefore, we are able to exceed the power metrics across the board for a diesel equivalent.”

Spent batteries on the unit can be swapped out with charged ones in roughly six minutes.

Giraldi told *E&MJ* AVS will release its fourth generation Z3 model at MINExpo. Details, he said, will be forthcoming.