The journey to the all-electric mine

Mehrzad Ashnagaran, Global Product Line Manager Electrification for the mining industry, ABB discusses why now is the time for the mining industry to embrace the all-electric revolution.

The landmark 2015 Paris Climate Agreement aims to strengthen the global response to the threat of climate change by limiting the global temperature rise this century to 1.5°C above pre-industrial levels. To date, 190 countries have ratified the treaty and the onus is now on companies from all industrial sectors to reduce carbon dioxide (CO_2) and other harmful emissions in line with national regulations.

For mining, that means employing new digital and automated solutions that optimise energy usage and promote alternative fuels, while also eliminating diesel - the largest source of CO_2 emissions in most open pit mines - by electrifying key applications such as haulage using trolley-assist systems.

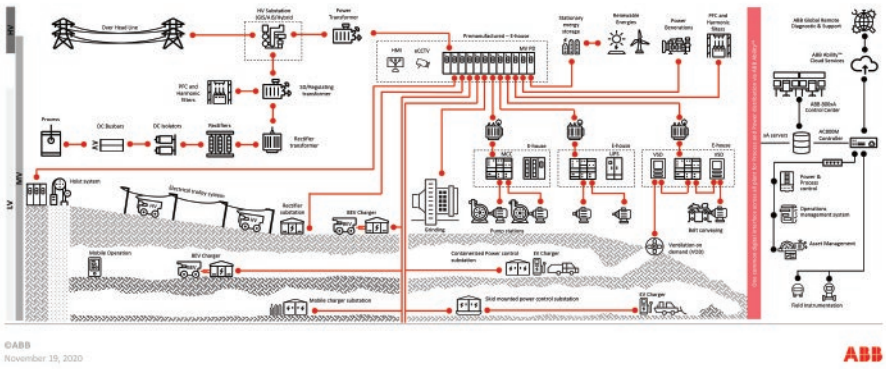

ABB Ability™ MineOptimize - plant-wide integrated electrification systems are customised and optimised for each application. Source: ABB

Truck trolley-assist lines

Large trucks can carry 3,000-5,000 litres of diesel in the tank and consume around 300-400 litres per hour while travelling up a 17 km ramp in half an hour. Cycle times mean that a truck with a full tank cannot complete an entire shift without stopping. They must either increase the speed of the mobile equipment or the size of the fleet; both options lead to increased emissions and capital expenditure.

Diesel-electric trucks with an on-board electrical system are now a reality in many mines and can be easily attached to a trolley line, leading to significant reductions in CO_2 and improved fuel economy. These new-generation vehicles can be driven fully electric using a powertrain in their wheels, and they also have an electrical genset on board.

Swedish company Boliden is trialling four electric haulage trucks on a 700 m trolley line at its Aitik copper mine with the aim of reducing annual diesel usage by 800,000 litres and carrying 70 million tons of ore every year without using fossil fuel. By going electric, the on-trolley trucks use just 30-50 litres an hour, which equates to a reduction in diesel consumption of as much as 350 litres an hour.

Boliden plans to install an additional 3 km of trolley line at Aitik, thus reducing greenhouse gas (GHG) emissions from transportation over the life of the open pit mine by nearly 15%. At the company's Kevitsa operation in northern Finland, the installation of 1.8 km of trolley line - plus the conversion of 13 diesel-electric haul trucks - equates to GHG reductions of 9%. Overall, Boliden says it will reduce its diesel consumption by 5,500 cu. m/yr when the investment at the two mines is complete.

Benefits of electrification

In addition to reducing harmful CO_2 and noise emissions, using diesel-electric trucks on trolley-assist lines offers tangible operational benefits, including boosting speed-on-grade for greater throughput, and reduced vehicle usage, allowing for more efficient maintenance planning, and ultimately better fleet availability and longevity. Improved air quality also equates to a safer working environment.

Reducing emissions through electrification also makes good business sense. Fossil fuel price volatility is making electricity more cost competitive. Capital expenditure on ventilation equipment to extract harmful gases from the mine is reduced. In addition, in light of the Paris Agreement, demand for clean energy minerals such as copper (wind turbines) and lithium (batteries) is set to continue rising. The case for electrification is also bolstered by the advent of taxes on CO_2 emissions, the removal of tax advantages from diesel, and premiums offered by energy suppliers to incentivise electricity use.

Roadmap to all-electric mines

Despite these, and other, benefits, we are some way off realising the vision of all-electric mines that incorporate optimal design and operations for balanced energy and resource consumption.

One issue is to do with mindset. The mining sector is traditionally conservative and risk averse, and has been relatively slow to embrace electrification, which brings new challenges in terms of planning, fleet management and skill sets. Asset lifecycle strategies, ownership models and duty cycles are all subject to revision. Helping mining companies manage significant energy costs is key. Meeting increased demand for the key commodities that will drive the transition to a clean energy future also requires a workforce that is literate in digital, automated and electrification technologies.

A 2019 EY report, commissioned by the Minerals Council of Australia, entitled 'The Future of Work: The Changing Skills Landscape for Miners', found that approximately 77% of occupations in the sector in Australia alone will be enhanced or redesigned due to technology. Skills with growing demand included system evaluation and analysis, data analysis, and data and digital literacy.

Existing battery technologies at surface mines are limited. We cannot yet manage large payload trucks of 280-400 tons fully battery equipped. To address this, companies are using solutions such as battery packs in an effort to close the gap between the trolley and the loading or dumping point.

At ABB, we have the knowhow and expertise to oversee and accelerate this transition, bringing to bear years of experience as a global electrification and charging partner for car, bus and truck OEMs. We stress the need for our experts to be involved at the earliest stage in the design of an all-electric mine. Collaboration is all-important, as is an integrated approach, allowing us to optimise plant operations, realise substantial cost savings, and reduce complexity across the entire mine process.

ABB sees the move away from diesel as progressive, an evolution from the 'first-generation' diesel electric trolley, to the battery trolley - and, finally, the integrated, all-electric mines of the future. The building blocks are being set in place with mindsets changing and technologies well on the way to reality. On top of this, business and legislative imperatives demand change. Crucially, this is coming from within big mining organisations and the supply chain, as well as policy makers. The time has come to accelerate the journey to the all-electric mine.

www.new.abb.com/mining/mineoptimize

Author: Mehrzad Ashnagaran, Global Product Line Manager Electrification for the mining industry, ABB