



Installation of SIEMAG TECBERG hoisting equipment at Sishanling iron ore mine near the city of Benxi in China

A long and winding road

Paul Moore looks at hoist projects, hoist control and hoist safety giving examples from the key technology players

While there is always a healthy market for smaller service hoists, there are actually relatively few really big mine production hoist projects being built currently – ABB supplied both the mechanical and electrical side for BHP's Jansen potash mine, cementing its dominance in the Saskatchewan potash industry in hoisting systems. Jansen is set to start production of Stage 1 in 2026. The friction hoists are 6 m in diameter with a total connected motor power of close to 14,000 kW.

Then there is Resolution Copper in Arizona (55% Rio Tinto/45% BHP) – even though the project has some way to go in terms of remaining permits and final approval. The existing No. 10 Shaft at Resolution is still the deepest in the US (28 ft diameter concrete line at a final depth of 6,943 ft) and the No. 9 Shaft reached the same depth at completion of a blind sinking deepening project, completed in early 2021. Resolution is now focused on the maintenance of Shaft 9 and 10 and continuing the underground characterisation study to increase ore-body knowledge. For Shaft 10 the current plans are to have a double drum hoist of nearly 7.6 m in diameter.

Another project worth watching is Ivanplats' Platreef in South Africa – its Shaft 1 is already using a winder for bulk sampling, ore delineation, Phase 1 mine development plus stoping and ventilation intake, bulk air cooling and as a secondary escape. It has a refurbished

double drum hoist – 4.88 m diameter, 2,322 kW. The auxiliary is a single drum hoist – 3.75 m diameter, 475 kW. But Shaft 2 will ultimately serve as the production shaft and primary access to the mine. It is set to be equipped for hoisting in 2025, allowing for first concentrate production in the latter half of that year.

It will be a 10 m diameter, 1,100 m deep concrete-lined shaft and will provide intake ventilation needs for the upper portion of the mine. Shaft 2 is planned to have three hoisting systems: ore handling and hoisting systems, the main personnel and materials transport cage, and an auxiliary personnel cage. There are additional provisions for primary mine services. Shaft 2 will feature two 40 t guided skips working in counterbalance. Total rock-hoisting capacity will be 6.4 Mt/y. It will be a 6 m double drum Koepe with 6.19 Mt/y capacity. DRA is now handling the hoist part of the project as part of its EPCM – FLSmidth did the early engineering for the auxiliary and service hoists which are going ahead as planned, but the final production hoist supplier for Shaft 2 has yet to be finalised.

SIEMAG progresses with Sishanling

However, one of the most impressive examples of ongoing hoist work today is in China. In early 2017, Tianjin SIEMAG TECBERG Machinery Co Ltd, a subsidiary of **SIEMAG TECBERG GmbH** headquartered in Haiger, Germany, and Benxi Longxin Mining Co Ltd, a company forming part

of Jianlong Group China, signed a supply agreement for three sets of hoisting & conveying systems to be divided between two shafts in the Sishanling iron ore mine near the city of Benxi in the Province of Liaoning in China.

The Sishanling iron ore mine is one of the largest iron ore mines currently being opened up in China and has 2.5 billion tonnes of proven iron ore reserves with an average iron content of about 31%. Because of the concentrated orebody and its even distribution these reserves are suitable for extraction on a large scale. They are the largest proven and registered iron ore deposits in China, having a long-term planned extraction capacity of 30 Mt/y. Initially 15 Mt/y will be achieved a year in the next five years.

The concept was optimised to two shafts each yielding 7.5 Mt/y. A service shaft equipped with a total of two service winders for the transport of personnel and machinery will also be sunk. The overall concept thus initially provides for a total of three hoisting systems: a double-skip production system in the production shaft in the form of a 6.75 m, six-rope machine and a cage counterweight system for personnel and machine transport in the form of a 6 m six-rope machine and a smaller cage counterweight system for emergencies in the form of a 4 m four-rope machine in the service shaft. Tianjin SIEMAG TECBERG says it won out against international and local competitors for the supply of all three hoisting systems, not least because of the company's capacity for system integration of very large, deep and complex shaft hoisting systems.

System 1 is a double-skip hoisting system – a tower-based six-rope Koepe hoisting machine, diameter 6.75 m, for skip hoisting (55 t payload per hoisting skip) at a depth of 1,500 m with an overall drive output of 16 MW (2 x 8 MW), which is designed for a hoisting performance of 7.5 Mt/y. It will use split plain bearings with bearing lubrication, one set of six-rope rope sheaves for rope deflection, an ST3-F (closed loop technology) hydraulic braking system with 12 pairs of BE 250 brake elements, four sets of Siemens SM150 DC indirect converters (IGCT), plus automation equipment including machine control system, energy distribution system and a shaft signalling and loading and unloading control system complete this hoisting system package.

System 2 is a large-cage hoisting system. A ground-based six-rope Koepe hoisting machine, diameter 6 m, for large-cage hoisting with a drive output of 3 MW (2 x 8 MW). Rolling bearings, two sets of six-rope rope sheaves for rope deflection, an ST3-F (closed loop technology) hydraulic braking system with 14 pairs of BE125 brake elements, two sets of Siemens SM150 indirect converters (IGBT), and again automation equipment including machine control system,

Resolution Copper's Shaft 10 will have one of the largest mining hoists ever installed



energy distribution system and a shaft signalling and loading and unloading control system.

Lastly system 3 is another cage hoisting system, a ground-based four-rope Koepe hoisting machine, diameter 4.5 m, for cage hoisting with a drive output of 1 MW. It has two sets of four-rope rope sheaves for rope deflection, an ST3-F (closed loop technology) hydraulic braking system with six pairs of BE125 brake elements, one set of Siemens SM150 indirect converters (IGBT) and automation equipment including machine control system complete this hoisting system package.

SIEMAG states: “The special feature of the three hoisting systems is the central control system. The control room is located in the hall of the hoisting machine of the service shaft. In normal operation the hoisting systems in the production and service shaft are all in automatic lifting operation. Furthermore, the two systems in the service shaft are fitted with wireless communication devices that enable the hoisting equipment to be controlled from the cage direct. This enables personnel to reach different levels direct.”

Early in 2022 SIEMAG TECBERG started on the installation of the equipment on site in Benxi. The operator Benxi Longxin has meanwhile begun with preparations for production shaft No. 2 in order to achieve the expansion level of 2 x 7.5 Mt/y in the medium term.

A new era of hoist control

ABB recently launched ABB Ability™ NGX Hoist Control, an automated, digital hoist control system evolved from ABB's reliable and proven past generations of hoist control systems, to enable mining companies to operate hoists with high levels of performance and safety using a standardised platform worldwide. The company says it brings new levels of reliability, flexibility and ease of use to smaller companies on greenfield projects or upgrades as well as global companies where standardisation of control systems delivers improved efficiency and reduced costs. ABB Ability™ NGX Hoist Control is adaptable to any type of hoist and can be used in upgrade projects even with third-party control systems. It has intuitive operation via a human machine interface system (HMI) and provides access to ABB expert technical support at all times.

ABB Ability™ NGX Hoist Control can be easily integrated with other market leading ABB technologies including ABB Ability™ Safety Plus for hoists – the first fully SIL 3 certified hoist solutions which ensure the highest level of safety – which was first commissioned in 2019 on the world's largest friction hoists. It is also compatible with advanced digital service ABB Ability™ Performance Optimization for hoists, a digital monitoring service that continuously tracks the status of a mine hoist and improves

uptime, availability, performance and productivity of mine hoists by providing actionable information on KPIs.

“This exciting new launch follows the recent introduction of ABB Ability™ Safety Plus and is another milestone for greater levels of reliability, optimisation and protection for mine hoists,” said Oswald Deuchar, Global Product Line Manager for Hoisting, ABB. “With ABB Ability™ NGX Hoist Control mine operators benefit from reduced downtime and lower maintenance requirements, including round-the-clock support and the ability to manage hoists for greater optimisation. By implementing the same control system across plants OPEX can be further improved.”

On the background to the solution, Deuchar told *IM*: “When we look at our customers, they are increasingly global, but traditionally the engineering for our hoist control systems has been conducted more regionally. All the solutions were good, it's just that the look and feel could be slightly different due to differences in electrical controls and software, for example between Asia and North America. The Tier 1 miners have staff moving around regularly to manage different sites or to assist with new project execution – we wanted to make sure we could offer our customers a platform that is consistent and that they will instantly recognise every time they see an ABB hoist. Going forward

FORGED FOR THE WORLD'S TOUGHEST PLACES



970.259.0412
MININGEQUIPMENTLTD.COM

A LEGACY OF DELIVERING

We pride ourselves on creating the most reliable equipment for the tunneling and mining industries. Because we understand the harsh environments where our fans are used, our equipment utilizes heavy gauge steel and forged fan blades to meet or exceed these tough demands, and in the end, save you money.

- COMPLETE VENTILATION SOLUTIONS
- FORGED BLADES
- SILENCERS AND NOISE SOLUTIONS
- FILTRATION SYSTEMS

as more mines start to be managed from Integrated Remote Operations Centres, it will also streamline hoist management for global miners.”

On projects, ABB offers both mechanical and the electrical/automation control side of the business. ABB recently won a large order for its highest payload Koepe production hoist, associated infrastructure and safety systems from Australia-based mining company OZ Minerals. The contract will help to ensure efficient processing performance and a long service life as part of an ongoing \$400 million expansion at the Prominent Hill mine in South Australia. The hoist, which will be designed and supplied by ABB, has a capacity of 39,400 kg and the strongest drivetrain that ABB has ever installed in Australia. ABB specialists will also supervise installation and commissioning. The hoisting shaft provides access to mineral resources outside the current trucking mine plan that would have been uneconomical via a trucking operation from around 2033. Installing the Wira shaft will increase the annual underground mining rate, extend the mine life, reduce operating costs, lower emissions intensity, and reduce overall operational risk, according to OZ Minerals.

Once operational, the installation at Prominent Hill will have ABB Ability™ Safety Plus for hoists, a suite of mine hoist safety products that brings the highest level of personnel and equipment safety available to the mining industry, the company said. It is the first fully SIL 3 (Safety Integrity Level) certified suite of solutions for hoists, rigorously examined and certified by an independent global functional safety certifying body, and strictly developed in accordance with the International “Safety of Machinery” standard IEC62061, the company said. The products include Safety Plus Hoist Monitor (SPHM), Safety Plus Hoist Protector (SPHP) and Safety Plus Brake System (SPBS) including Safety Brake Hydraulics (SBH).

Odyssey and Odysseus

Another major hoist project in development worldwide is at the new Odyssey Mine, located near the town of Malartic in the Abitibi-Témiscamingue region of northern Quebec, which will extract ore from an orebody that lies underneath the historical East Malartic Gold Mines. The mine is owned and will be operated by Canadian Malartic Partnership (Yamana Gold 50%/Agnico Eagle 50%). The production hoist will be a new Blair double drum Multi-Rope hoist which allows the operation of two 47.35 t skips. It will have four 63.5 mm ropes with two sets of compensating sheaves. The drum’s diameter will be 7.12 m and each drum is driven by 12,000 HP AC motors. The designed hoisting speed for the



Construction at Canadian Malartic's Odyssey gold mine in Quebec

production is 18 m/s. The supplier has yet to be specified, similarly not as yet for the service hoist which will consist of a single drum type to be used for two purposes during its operation. It will be used to hoist a cage-skip single deck with a capacity of 11.3 t or 36 workers and later on will be replaced with a double deck service cage for personnel and material. The service hoist is designed to operate at a speed of 8 m/s and will haul at maximum speed while hoisting material/waste but is limited at 8 m/s for personnel haulage. The 4,877 mm diameter drum is driven by a 4,000 HP motor. Finally, FLSmidth has already supplied and installed the auxiliary hoist, again a single drum type of hoist which will be used for hauling workers in a double-deck cage of nine workers per deck capacity. It has a 2,438 mm diameter drum driven by one 850 HP motor and is designed to operate at a speed of 8 m/s.

Over in Australia, in 2022, the Cosmos Nickel Operation was acquired by IGO as part of the acquisition of Western Areas. IGO is currently developing the Odysseus Underground Mine at the Cosmos Nickel Operation. Once in production, Odysseus will deliver high quality nickel concentrates into the global nickel market which is growing rapidly driven by demand for nickel rich lithium-ion batteries. The primary ventilation shaft consists of a 5 m-wide and 1,000 m-deep intake shaft which will also serve as a production hoisting shaft and a partially reamed 5m exhaust raise. The hoisting shaft will be capable of accommodating up to 1.1 Mt of ore and waste a year and will be equipped with a mid-shaft loading station (MSLS) and a bottom shaft loading station (BSLS). The hoist is a refurbished FLSmidth legacy brand hoist originally delivered for Impala Platinum’s Shaft 12 North in South Africa, which was shipped to Australia and is in the process of being installed.

From hoist supply to safety brakes

FLSmidth is one of the global leaders on the mechanical and hydraulics side of hoist supply including three kinds of hoisting systems: Koepe Hoists, Drum Hoists, and Blair Multi-Rope (BMR) Hoists. Its hoists can be made with drum

diameters less than 1 m and up to more than 6 m. This can be done with a double or single drum configuration. FLSmidth hoists can also have dual clutched drums. On electricals and control systems it works with whoever the customer or EPCM specifies. An example is a project working with ABB at Vale’s Copper Cliff South operation or with Actom using GE Power Conversion technology in Africa such as at Glencore Mopani Copper Mines in Zambia.

One of its recent innovations in mechanical hoist solutions is the Crank Type Dump Mechanism for skip unloading which replaces more expensive hydraulic units while optimising skip cycle times and reducing headframe height requirements in comparison to scroll-type discharge systems. **IM** spoke to one of the original developers, Francois Koekemoer, Mechanical Design Engineer - Mine Shaft Systems at FLSmidth: “It’s going well – as is typical in mining nobody wants to be first, however, we’ve seen great interest and have done some upfront CTDM engineering for some of our customers and where it is very likely to be installed in the medium term.”

FLSmidth also offers Brake Control Systems and its most recent innovation on that front is its patented Cage Guardian™ Safety Brake, developed out of its Orillia, Ontario office. Koekemoer says: “It’s now been installed at mines in both Canada but also in Finland. In the Canadian market, safety brakes always need to be installed on the conveyances themselves and until now there was no steel guide system that met all the functional requirements.” For years, safety catches and timber guides have been the most relied-upon solution. But consistency amongst timber guides is difficult to achieve – wood is subject to moisture and defect issues, spare timber guides must be stored correctly and once a safety catch event occurs, the timber guide must be replaced. And, obtaining high-quality timber guides is becoming more and more difficult. Offering increased durability and matchless dependability, the patent pending Cage Guardian Safety Brake forgoes conventional safety catches and timber guides, and instead uses engineered steel guides.



The patented FLSmidth Cage Guardian Safety Brake system uses engineered steel guides and a self contained brake path

The safety brake is designed to deploy automatically in the event of a slack-rope or rope-break suspension failure. When such an event occurs, actuation and operation is performed by redundant mechanical systems, automatically arresting and holding the cage securely in place within the shaft. Suspension failure events generally cause no permanent damage to any of the Cage Guardian Safety Brake components, and the cage can then be retrieved and redeployed.

Built for control, longevity, reliability and low maintenance, the Cage Guardian™ Safety Brake is designed for use on conveyances running on tubular or top-hat-shaped steel guides and uses a self-contained brake path rather than relying on shaft guides for full braking performance. The Cage Guardian Safety Brake is an economic solution compared to multi-rope redundancy (Blair multi-rope hoists with compensating sheaves or multi-rope Koepe hoists), where multiple ropes are used to negate the requirement for a safety catch while operating on steel guides. Additionally, users can enjoy the security of proven equipment, because every brake is free-fall tested and certified before it is installed.

A new overwind protection system

Overwinding might become a serious issue, in case when all emergency systems have failures.

In the worst -case-scenario, heavy accidents would be the result if a loaded cage crashes into the shaft.


To avoid the worst case scenario, Germany based **OLKO-Maschinentechnik GmbH** recently developed and tested a new overwind protection system called Energy Absorption System (EAS). The conceptual idea was to invent a new system like a crash box - similar to an impact absorber in vehicle - which absorbs energy through the deformation of the crash box material. The system allows the mine operator to easily replace damaged parts of the overwind protection system and hence reduce shutdown times in the unlikely event of an accident caused by overwinding.

Early on, various materials, absorption processes and designs suitable for absorbers were tested. After analysing suitable geometrical designs of the crash structures and their absorption rates using force curves, extensive static and dynamic experiments were conducted in order to find the optimal material for the application. The experiments included foam, honeycomb and sheet structures as well as various metals, plastics and composite materials and many more. The result: composite materials showed very good linearity in terms of energy reduction and a high continuity in terms of the force progression.

All the results of the experiments were

combined and a design concept was contrived. Stacked absorption plates should be destroyed using a plow, continuously absorbing the kinetic energy of the system.

In order to verify these results, gained on a small scale, a drop tower was designed. Using the drop tower, different combinations of drop mass, material thickness and plow width were investigated, while the drop height remained constant. After each test the low penetration depth into our material was measured and the specific energy absorption rates were calculated as well as the theoretical velocity at the point of impact. Additionally, v/t measurements were performed using special high-speed camera technology and coinciding accelerometers were used to validate the results.

OLKO's Carsten Schmidt, Deputy Managing Director, told **IM**: "The results of these experiments aligned closely with our expectations and theoretical calculation, mainly: linearity and low scatter of energy absorption and retardation; plus optimised Specific Energy Absorption rate." He says the patented EAS overwind protection system offers an alternative to established solutions offering several advantages - little weight of the system and absorption material, no limitations in regard to necessary energy absorption rates and shorter downtimes as damaged parts can easily and cheaply be replaced. 



Shaft Hosting Technology Made in Germany



OLKO-Maschinentechnik GmbH
Schlosserstrasse 55
59399 Olfen / Germany
Phone: +49 2595 / 38599-0
Mail: info-olko@ts-gruppe.com

Website: www.ts-olko.com