



# Aitik automation



*At full capacity the mine, in Arctic Sweden, can process 100,000 t/d of ore*

The expansion of Aitik, Sweden's largest mine, was opened at the end of August by King Carl XVI Gustaf. The expansion, which will double ore production, is one of the biggest industrial investments in Sweden in recent years. High level automation is essential to project success

Aitik is one of Boliden's four mining areas. The Aitik open pit in northern Sweden mines ore containing copper, gold and silver. Over SEK6 billion have been invested with a view to increasing the production rate and extending the mine's lifespan, while simultaneously achieving advantages of scale and reducing the cost per tonne produced (*IM*, March 2008 pp8-14). A new concentrator has been constructed, with new facilities for concentration, ore production and outward deliveries. The project was started in 2006 and completed in the first half of 2010. Production is now successively being ramped up, and will achieve an annual capacity of 36 Mt of ore in 2014.

"The project has been carried out at full speed despite the deep recession incurring low metal prices during much of the project time, so now we're opening the extended mine right at a time when global demand for copper is high," declared Boliden's President & CEO, Lennart Evrell.

"This project is the biggest in Boliden's history, and it will extend our largest mine's lifespan by over 10 years. The project has been completed on time, and now we're working on improving production stability," explained Jan Moström, President Business Area Mines.

The mine has to be highly efficient to survive; its head grade is so low – less than

0.3% Cu – that it can only be extracted profitably if the processes are highly automated. It is also very important to minimise electricity consumption, which runs at 1.5% of Sweden's total electrical power consumption.

A three-year, \$790 million modernisation of the entire operation, including new power and automation solutions from ABB, has enabled Boliden to double production with just 10% more employees.

Aitik is the largest open-pit copper mine in Europe and a world mining industry benchmark in mine efficiency. Output after the overhaul is set to rise from 43 t to 55 t/man-hour of work, Boliden says. As a result, the company can mine even lower-grade ore, allowing it to raise the mine's productive life by 13 years to 2029.

ABB has played a pivotal role in the program, supplying products and systems worth some \$84 million to power and automate the entire site. The entire site process – including the concentrator, conveyor systems and pumping stations – are controlled by ABB's Extended Automation System 800xA

At full capacity, the mine is capable of processing about 100,000 t/d of ore. The mining side of the operation was described in detail in the March 2008 article. The main change since then is that Aitik, in a major

change of technology is starting to take delivery of a fleet of Caterpillar 795F AC trucks. In other words, it is moving from mechanical to electric drive trucks.

These 313 t capacity (nominal) trucks deliver ore to an in-pit crusher inside the pit where it is reduced to a maximum size of about 600 mm in diameter. A new Sandvik in-pit, semi-mobile crusher has been built on the 285 m level. A conveyor system, partially running underground through the side of the pit, delivers the ore to a storage area on the surface. From here, ore is conveyed to the concentrator several kilometres away on a 2,000 mm wide belt conveyor operating at 4.8 m/s. The location of the new concentrator was chosen for its proximity to the tailings management facility (TMF). Slurry pumping economics for the tailings determined that the distance of the concentrator from the pit was far less important than its distance from the TMF. There is a 200,000 t (two days production) ore stockpile at the concentrator.

Trucks also dump near-surface ore into a second, new Sandvik semi-mobile crusher located near the intermediate storage facility. Sandvik supplied a comprehensive in-pit crushing system, valued at some €125.5 million, consisting of two complete primary gyratory crushing stations (with apron feeders) as well as overland conveyors. The system has



### safety whips

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a capacity of 8,000 t/h and transports the ore 7 km, with the conveyor running in underground drifts for almost half of that distance. The new crushing and conveying system was put into operation in early 2010. Sandvik's scope of work included engineering and erection as well as start-up services.

Boliden's decision to invest in a conveying system reduces the use of truck haulage and the system provides higher availability, considerably lower running costs and is more environmentally friendly than trucks, Sandvik reported.

Around 650 ABB high-efficiency motors, many of them equipped with variable speed drives, power the conveyors, crushers, pumps, fans and process equipment to ensure minimal energy use and maximum process efficiency.

The entire site process – including the concentrator plant, conveyor systems and pumping stations – is controlled by ABB's Extended Automation System 800xA. Boliden selected System 800xA as its group-wide process automation platform several years ago following extensive tests and comparisons with other automation systems. The 800xA receives 7,000-8,000 input signals.

ABB supplied four drive systems, all controlled by the 800xA, for the 3 km overland conveyor – two 2.36 MW units and two 1.8 MW units. The system can run with just three of these drives on line. That is important in the winter when a conveyor stoppage which allow all the material on the belts to freeze.

Controlled soft starting and operation of the equipment is important. ABB's Overland Conveyor (OLC) Drive Solutions provide OLC-specific functionality, such as load sharing, soft start under all load conditions, various braking and stop functions, and more.

An ABB gas-insulated substation feeds electricity from the grid to Aitik with minimal electrical losses and minimal space requirements, and a harmonics and power factor correction filter system ensures that Boliden can operate the powerful GMD system of its huge AG mills without distorting the supply network and incurring monetary fines from the power utility (Vattenfall). The harmonic filter deals with three branches, each with three steps controlled by the 800xA. The harmonic distortions in the grid are kept below the limits given by IEC/local standards and the



graco



*The harmonic filter deals with three branches, each with three steps controlled by the 800xA. The harmonic distortions in the grid are kept below the limits given by IEC/local standards and the installed filter and power factor correction system ensure the power factor is equal to or higher than 0.99*

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ABB low-voltage switchgear distributes power across the entire Aitik site, reliably and energy efficiently. There are 12 x 22 kV sub stations on site, with 9 km being the longest transmission distance. To avoid unacceptable power loss over this distance 22 kV was chosen in preference to 10 kV. Power is transformed down from the 154 kV supplied by Vattenfall.

### Decreased maintenance

xA stands for 'extended automation and ABB's award winning System 800xA provides an automation platform with incredible connectivity capabilities that creates one flexible, integrated, collaborative environment. Integration of systems, applications and devices into a powerful information architecture makes all information available for use in the system and provides information to plant personnel in actionable context. This is what Boliden wanted, it was imperative to avoid creating 'islands of information' that are disconnected from each other. This System 800xA shows both material flow through the concentrator and electrical flow around the whole Aitik complex. It controls the concentrator, conveyors, pumping systems and even the mine's own sewage plant. The solutions it offers include:

- Promoting collaboration through integrated plant systems and applications
- Improving operator effectiveness through integrated information
- Generating cost effective solutions through integrated engineering
- Achieving seamless control through integrated, unified fieldbus networks
- Providing flexible evolution paths through seamlessly integrated controller platforms.

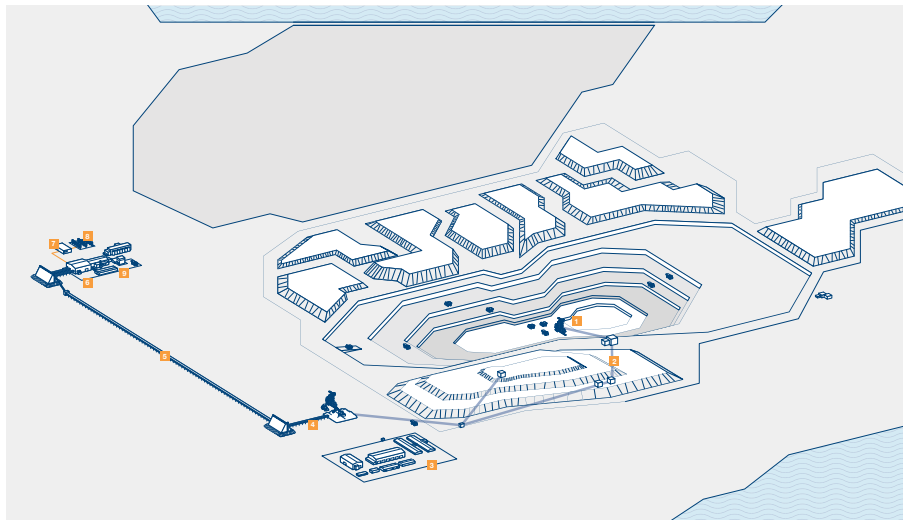
Aitik is ABB's first plant in the world to use asset optimisation through the 800xA. This allows Boliden to rely on predictive maintenance, which shows that equipment needing maintenance and allowing management to ignore the equipment where no maintenance is needed (until such time that it is). This means that unnecessary maintenance is avoided and therefore decreases maintenance costs. To achieve this, the System 800xA has been integrated with the mine's IBM Maximo maintenance system and with its document management system.

Aitik is also one of the first industrial sites in the world to use the new IEC 61850 international standard that defines communication within and



Aitik mine  
Overview of ABB delivery

- [1] In-pit crusher
  - Motors
  - Drives
- [2] Underground conveyor
  - Motors
  - Drives
  - Distribution transformers
- [3] Truck workshop
  - Low-voltage switchgear
- [4] Intermediate storage
  - Low-voltage switchgear
- [5] Overland conveyor
  - Motors
  - Drives
  - Distribution transformers
- [6] Concentrator plant
  - Gearless mill drives
  - Dual pinion drive systems
  - Permanent magnet motors
  - Distribution transformers
  - Low-voltage switchgear
  - Motors
  - Drives
- [7] Substation
  - Gas-insulated switchgear
  - Transformers
  - Medium-voltage switchgear
- [8] Harmonic filter system
- [9] Control room
  - Extended Automation System 800xA



Layout of the new Aitik operation showing various technologies supplied by ABB

between electrical components. This means that the System 800xA provides a single environment by which to control and supervise process automation equipment, power automation equipment, as well as protection, switchgear, transmission and distribution equipment.

## twiflex

The integration of the electrical control system into the process control system at the plant increases productivity and reduces stoppages by permitting a single strategy in engineering, maintenance and operations. Furthermore, ABB explains, "the adoption of a global standard based on the latest technology

enables lower installation and operational costs, as well as enhanced visibility of the power usage and consumption.

ABB's delivery for the expansion project, valued at \$84 million, includes:

- 650 motors (ranging in power from 4 kW to 3.36 MW) for conveyors, pumps, fans, crushers, mills and process equipment
- 230 drives and variable-speed drives to control the electric motors
- Two 22.5 MW GMDs
- Two 2 x 5 MW dual pinion drive systems for pebble mills
- Four 1.4 MW permanent-magnet motors for slurry pumps
- Process control

system (Extended Automation System 800xA)

- 23 distribution transformers for drive systems
- Three 80 MVA power transformers for substation
- Gas-insulated switchgear (170 kV) for substation
- Harmonic filter system for the complete plant
- 201 cubicles of low-voltage switchgear (400-690 V) for distribution of power across the site
- Service contracts

ABB has won a maintenance service contract from Boliden to maintain the power and automation solutions it has delivered to Aitik. ABB is responsible for managing maintenance schedules so that high performance and efficiency are preserved with minimal maintenance stops, lower operating costs and no breakdowns.

The service contract deals with all Boliden's needs including a support line 24/7, the provision of quarterly remote service reports, regular preventive maintenance scheduled to meet Boliden's requirements with a reliable, well-managed supply of spare parts to guarantee optimal mining operations.

"This is a unique contract for ABB that demonstrates our ability to provide a comprehensive service package for power and automation equipment. This could be a model for all mining sites with ABB equipment around the world," said Hans Eckerrot, Head of ABB's Service Business in Sweden.

The service contract covers the process control system (800xA), medium-voltage converters, GMDs, low-voltage converters, low-voltage motors, and power equipment such as transformers, gas-insulated switchgear, switchboards, breakers, relay and auxiliary supply systems.

"The System 800xA platform will give us the opportunity to include predictive maintenance software components integrated with the customers' maintenance system, and thereby further improve the OEE (Overall Equipment Effectiveness) while reducing maintenance costs," Eckerrot added.

## New 106,000 t/d concentrator

The volume of the new concentrator main building is 710,000 m<sup>3</sup>, larger than Stockholm's Globe Arena. Here two ABB gearless mill drives (GMDs) – the most powerful ever built – power two new mills that grind the ore to sand from which the copper





can be extracted. Each GMD is rated at 22.5 MW enabling the mills to grind up to 2,200 t/h of ore each.

The two milling lines were supplied by Metso, with a nominal capacity of 2,200 t/h - primary 22.5-MW mill, 11.58 x 13.72 m, with ring motor, the largest ever supplied by Metso

Minerals weighing 800 t each. The order was worth some €39 million and besides the AG mills included two pebble mills. Metso also provided engineering, erection and start-up services.

A total of 72 poles around the mill flange run the AG mill GMD. It rotates at 9.8 rpm Ore

*Two of the largest grinding mills commercially available and supplied by Metso have replaced the existing five mills. These 22.5 MW primary mills with wrap around motors measure 11.6 m in diameter x 13.7 m. Twiflex/Hilliard supplied its largest grinding mill braking system to Metso for installation on the AG gearless driven (ABB) mills*

at a maximum size of 600 mm entering the mill is discharged in slurry with 80 % minus 180  $\mu\text{m}$ .

The Russell Mineral Equipment (RME) Mill Relining Machine (MRM-8) for the AG mill is an eight-axis machine with a rated capacity of 3,500 kg. The mill uses rubber liners (with a steel cap in the AG mills). MRM-8s are recommended for all medium to large SAG and AG mills with individual liners weighing up to 7,500 kg). The eighth axis, known as the 'grapple telescope axis' provides an additional, plunging action used for inserting deep liners such as pulp lifters. "With this additional function, liner placement rates are maximised across a wide range of machine operator skill levels," RME says.

"Machine-to-liner interface is via RME's hydraulic powered New Liner Pinning Tool, integrated into the four function grapple. Worn liners are handled by the grapple's rigging hook and RME's Worn Liner Lifting Tools."

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*Sami Grönstrand, Outotec's Head of Flotation and Hydro Plant Equipment Product Line, told IM that the flotation section of the plant "was built to minimise operating cost, hence it is quite tall and relies on gravitational pulp transportation as much as possible" (rather than pumps).*

project comprised flotation cells fully installed with auxiliary systems. The TankCell® units feature the latest field-proven and patented FloatForce™ mixing technology developed by Outotec.

There are two parallel lines of 13 TankCell 160s (26 in total) in rougher and scavenger duty. Two parallel lines of seven TankCell 50s each (14 total) are in first cleaner duty. Then there are subsequent lines for the second cleaning (single line of five TankCell 40s), third cleaning (single line of four TankCell 40s) and fourth cleaning (single line of three TankCell 40s) stages.

Each cell is equipped with individual level

The Twiflex braking system on the AG mills is designed specifically for such installations, giving both static and dynamic braking. In static operation the braking system is used to hold the mill during liner replacement and general mill maintenance.

For dynamic operation the system can operate in two modes, stopping the mill from full speed in an emergency or providing inching/creeping functions in the event of bearing lubrication problems or power failures.

For the first, a controlled application of the brakes is required and for the second, the brakes are operated quickly to give accurate stops needed by the mill operator.

Eight Twiflex VMS-DP brake callipers with pedestals plus hydraulic power pack were supplied for each primary mill. The VMS-DP calliper has an adjustable braking force from 590 to 737 kN and is a floating spring-applied, hydraulically-retracted brake suitable for disc/flange thicknesses from 117 to 130 mm.

The brake can be used on installations with a braking path of at least 7.6 m outside diameter (there is no upper limit) and 7 m inside diameter. The hydraulic power pack offers an advanced and versatile brake control as it allows both local and remote operation for inching and creeping duties through a control panel.

The braking system at Aitik can generate up to 38 MNm braking torque for each mill acting on a 12.97 m mill flange diameter. The VMS-DP callipers weigh 1.67 t each and are able to deliver 940 kN clamping force. With a full process charge the braking system is able to stop a mill in less than 2 seconds.

Outotec won the contract to supply the complete flotation circuit for Aitik. Boliden had already ordered engineering services from Outotec for the same project. The total value of these contracts was some €25 million. Outotec's scope in this engineering and supply

## PUTZMEISTER



Bredel SPX100 high-pressure hose pump below one of the thickeners. Its inner hose diameter is 100 mm, minimum starting torque 4,650 Nm and capacity per revolution is 40 litres. It offers a maximum flow rate of 72,000 litres/h (continuous) and 108,000 litres/h (intermittent)

and air control. Depyritisation flotation cells reduce the acid generation potential of the tailings.

Outotec also delivered a regrinding pebble

mill for Aitik.

There are two thickeners, each with a capacity of 2 million litres. There are also three pressure filters (replacing dryers and cutting

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dust emissions to zero). These result in a final product with a moisture content of 7%.

Located near Gällivare, in the arctic Lapland region of Sweden, the copper deposit at Aitik was discovered in the 1930s although mining only began in 1968 when technology was sufficiently advanced to profitably extract the metal. Today the pit is 2.5 km long, 1 km wide and 420 m deep and the remaining reserves are estimated at 747 Mt of ore grading 0.25% Cu, 0.15 g/t Au and 1.7 g/t Ag. Copper concentrate containing about 27% copper, 250 g/t silver and 8 g/t gold is taken by rail to Boliden's Rönnskär smelter for further processing. **IM**

**Boliden Mineral - the AITIK 36 expansion project at a glance**

**Two crusher plants, 8,000 t/h**

Supplier: Sandvik  
Apron Feeder type CAT D11  
Gyratory crusher type Fuller-Traylor NT 60" x 113"  
Hydraulic rock breaker type Rammer G90 City (Sandvik)

**7 km conveyors, 8,000 t/h**

Supplier: Sandvik  
Belt width: 2,000 mm  
Speed: 4.8 m/s for the long overland conveyor

**Two grinding lines, 2,200 t/h each**

Supplier: Metso  
Each line consists of:

- 38' x 45', 22.5 MW gearless drive AG mill
- 30' x 38', 10 MW pebble mill

**Spiral classifiers**

Supplier: FLSmidth - four 78" Wemco Duplex classifiers

**Flotation**

Supplier: Outotec  
26 TankCell 160 XHD  
14 TankCell 50  
12 TankCell 40

**Hydrocyclones**

Supplier: Weir - five 500CVX10 Weir Minerals Cavex cyclones and six 400CVX10 Cavex Cyclones

**Thickeners**

Supplier: FLSmidth - two 22 m Eimco Hi-Rate Thickeners

**Filters**

Supplier: Metso - three VPA 1540-54 pressure filters

**Slurry Pumps**

Suppliers: Weir for grinding and Metso for flotation and dewatering

**Pebble Conveyors**

Supplier: Paakkola

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