



Boliden mines economies of scale

Doubling copper output

To maintain cost-effective copper production Boliden AB is undertaking the Aitik 36 project. This will double concentrator capacity at the Swedish operation and require a proportionate increase in mined ore output. Atlas Copco is supplying a fleet of four Pit Viper PV-351E drilling rigs, two of which are already operating.

Aitik 36 on track

New Boliden, Sweden's major integrated non-ferrous mining and metals producer, is the third largest copper metals supplier and the third largest zinc metals supplier in Europe. The company operates primary zinc production facilities at Kokkola in Finland and Odda in Norway, a copper smelter and refinery at Harjavalta and Pori in Finland, and the Rönnskär complex at Skelleftehamn on Sweden's Baltic coast, which treats various concentrates and scrap to yield refined copper, lead, precious metals and zinc clinker. The largest supplier of copper concentrates to Rönnskär is Boliden's Aitik open-pit mine near Gällivare, 400 km by rail from Skelleftehamn. The Aitik 36 project is designed to keep this feed stream cost competitive. "The investment will make Aitik one of the most efficient mines in the world, and will substantially improve its competitiveness. This will, in turn, generate the preconditions for healthy profits and cash flows in the future," says Boliden's President and CEO Jan Johansson at the time the project was approved.

When Boliden started mining at Aitik in 1968, it was one of the world's first large, very low-grade ore copper mines to be developed in a high-wage economy. As well as utilizing the most cost-effective technology available, Boliden has raised capacity on several occasions in order to contain concentrate



The Aitik 36 project will raise ore production from 18 Mt/y in 1998 up to 36 Mt/y by 2012. The investment will make Aitik one of the most cost-efficient mines in the world.

production costs. Aitik 36 is by far the largest of these expansions. From an initial 2 Mt/y the company had raised ore production and treatment capacity in stages to 18 Mt/y by 1998; by 2012 the present project will take it up to 36 Mt/y. Aitik 36 involves a largely new in-pit crushing and conveying system and a completely new state-of-the-art concentrator facility that will replace the existing one after a short period of combined operation. The new facilities are scheduled to start up in 2010 and, although Boliden has reduced copper production this year in response to market conditions, the company has kept Aitik 36 on the original time track, good news for the several companies supplying and/or working on the project.

There has been no major new ore discovery and this massive expansion will not necessitate development of a new mine at this stage. What mainly made the expansion feasible was a new state-of-the-art and larger scale concentrator,

which will be able to improve the operation's economics while treating even lower ore head grades than the 0.44 percent copper, 0.22 g/t gold and 3.61 g/t silver that Aitik milled in 2005. Helped by positive exploration results in the pit area, this new parameter tripled proven and probable reserves from 219 to 630 Mt. As of December 2006 proven ore reserves totalled 520 Mt, grading 0.29 percent copper, 0.2 g/t gold and 2.0 g/t silver, while probable reserves were 110 Mt and the overall resource stood at approximately one billion metric tons. The ore available also includes recoverable amounts of molybdenum. Boliden initiated the Aitik 36 Project in 2007.

At present the open pit is 3,000 meter long, 1,100 meter wide and 405 meter deep. However, to achieve the necessary ore extraction rate, Aitik must cut back the mine boundary in a number of places, including the area where some of the office and workshop facilities are located. This, in conjunction with the



Boliden undertook a thorough evaluation before deciding to invest in four new Pit Viper 351E rotary drill rigs. Boliden's criteria included the ability to drill 311 mm holes to a depth of 19 meter. In addition they looked for safety and productivity enhancing features.

age of some of the machines in use at the time, has required a considerable outlay on new mining equipment. Boliden undertook a thorough evaluation of the options for this purchase program in 2007.

Switching to Atlas Copco

This exercise led the Aitik mine management to increase loading and haulage capacity by buying new models from the companies that had supplied the existing fleets. But, when it came to drilling rigs, the evaluation persuaded Boliden to switch manufacturer.

Like the rope shovels and the hydraulic excavators in use, the drill rigs would use the mine's electric power supply network. In deciding how to replace the four electric drive rotary head rigs then in use with four new ones, Boliden's criteria also included the ability to single pass drill 311-mm diameter holes to a depth of at least 19 meter. In addition, Aitik looked for good built-in safety and productivity enhancing features such as finger-tip joystick controls, programmable automatic drilling modes, GPS-based hole navigation, an operator-friendly cabin, ease of raising and lowering the tower for tramming, and the ability to drill angled holes.

With an operating weight of 185 tons and offering single-pass drilling to 19.8 meter and hole diameters from 270 - 406 mm, the electric version of the hydraulic drive rotary head Pit Viper (PV-351E) that Atlas Copco offered ticked Boliden's boxes. This was not a new model; several of these rigs had been supplied to customers in South Africa and Chile. However, it did now have Atlas Copco's Rig Control System technology with touch screen in-cabin display and a choice of three automatic drilling modes, plus the manufacturer's Rig Remote Access system for maintenance problem-solving. Accesses are safe and four cameras that display different views on a screen in the cabin provide good visibility where there is no sight line. In particular the 45-foot tower can be lowered in a few minutes, enabling much quicker relocation times than some competing rigs can achieve. The up to 30-degree angle drilling option is relatively expensive



The PV-351 could offer features like finger-tip joystick controls, a comfortable cabin, ability to drill angled holes, and ease of raising and lowering the tower for tramping.



The typical hole spacing for the PV-351E is 7 x 9 m, drilling vertical holes to a depth of 19.5 m using two 9.9 m drill pipe in a single pass.

but Aitik calculated that having it fitted to just two of the four rigs would achieve the degree of operational flexibility required. A very significant factor was that the operators participating in the different evaluation tests endorsed the joystick control system, said Patrik Gillerstedt mine manager.

During 2008 Boliden and Atlas Copco started to prepare for the staged delivery of the PV-351E rigs. Technical supervisor Stefan Kuoppa, who has been with Atlas Copco since 2001 and is normally based at the Atlas Copco CMT Sweden branch in Kiruna, visited the ADS headquarters in Garland, Texas for intensive training on the assembly and maintenance of the rig. He moved into Aitik during November 2008. Two Boliden operators spent almost three weeks in Garland to familiarize themselves with the rig, and Atlas Copco has also trained present Boliden operators to train new ones.

The first two units – the ones fitted with the angle drilling option – were delivered to the mine on several trucks, and assembly of the first Pit Viper was completed in January 2009. Kuoppa's local Atlas Copco team worked with Aitik engineering personnel under the

guidance of ADS experts from Garland. Not surprisingly assembly of the second rig took a good deal less time than the first. The rigs are maintained by Aitik staff, supervised by Stefan Kuoppa who commented that they had not experienced any significant problems when working on the Pit Vipers.

When we visited Aitik, Stefan Kuoppa and Emil Nyström had recently started work on the third Pit Viper with the Aitik technicians, but without any staff from the United States. The team was ready to lift the tower into place. Emil would supervise the job while Stefan went on vacation.

Hands-on experience

At Aitik, Boliden divides the production drilling workload between a major Swedish contractor, NCC Roads, and its own drilling team. NCC does the presplit drilling with a fleet of Atlas Copco ROC L8 DTH rigs and Boliden does all the rotary blasthole drilling.

For bench blasthole drilling the typical hole spacing is 7-by-9 metres and the rigs drill 200 – 300 holes for a blasting round designed to yield around 700,000 tons of rock. Orica is contracted

to charge each hole with about a ton of Fortis Advantage emulsion explosive. The constituents are stored in Gällivare and mixed at the mine. The explosive is delivered and charged by purpose-built truck. Drilling patterns are transmitted from the mine office to the Pit Vipers using the mine's W-LAN network but Aitik intends soon to use the Minestar system installed in 2007-8.

By early July the first PV-351E to be assembled had been working for 2,100 hours and the second for nearly 1,400 hours. Drilling with the Pit Viper is a one-person operation but the operator of a hired-in wheel loader does the cable shifting when moving between benches. As well as the Atlas Copco rig being very heavy and very large (16.4 meter long, 8.1 meter wide and 31.4 meter high with tower up), the hydraulic drives, cable feed system and rig control technology make the PV-351E quite different to operate from the rigs already in use. Nevertheless, according to driller Gerd Martinsson, the PV-351E is rather easy to handle. She has been working at Boliden since 1995, and as a drill operator for the last three years.

Even more experienced is Johnny Holmlander, one of the Aitik operators



The drill rigs drill 200 – 300 holes for one blasting round and the penetration rate can vary between 0.4 m/min in the upper part and 0.1 m/min in the harder rock types. Orica is contracted to charge each hole with about a ton of Fortis Advantage emulsion. Drilling patterns are transmitted from the mine office to the Pit Vipers using the mine's W-LAN network.



The Atlas Copco RCS touch screen in-cabin display.

who visited Garland for training. He has been drilling for 34 years and has worked at Aitik since 1979. We joined him in the cabin as he was about to navigate the PV-351E close to the bench edge, ready to drill Hole 72. Equipped with two 9.9 meter drill pipes and 311-mm bit, the Pit Viper was to drill

this hole to a depth of 19.50 meters in a single pass. Holmlander commented that more typical depths were in the 17 – 18 meter range. He explained that the rig can drill at a penetration rate of 40 cm per minute in the upper part of this bench but the rate can drop to 9-10 cm/min in the harder rock types at Aitik. The operator's sight lines to the tower and drill table unit are good, and the automatic drilling modes work very well in consistent rock, as well as the auto leveling feature that reduces wear and tear on the machine structure. The bit diameter is around 1,000 m, he said.

Meanwhile, NCC Roads, a contract driller working at the mine, ordered two new ROC L8-30 Mk II rigs, which are currently up and running at the mine, replacing older rigs. The Atlas Copco ROC L8 does not have the RCS system yet, points out Stig Fredriksson, the sales engineer based at Atlas Copco CMT Sweden branch in Luleå. But he hopes that when Aitik production is

running at 36Mt/y ore there will be more L8-30 rigs at the mine, and they will probably have the RCS-system.

Future options

So far, Patrik Gillerstedt says, he is satisfied with the PV-351E rigs' progress. Now that Aitik management and operators have a clear idea of the PV351's capabilities and characteristics in operation, they are assessing the possible use of further technical options that are available, such as auto tramping, and teleremote control.

Meanwhile, Boliden is planning development of a new supplementary open pit, Salmijärvi, a short distance southeast of the present Aitik pit.

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