

Drilling – the challenge for economy, mathematics and technique



"Don't listen to what they say. Go see."

On the north part of Sweden, about 700 kilometers to the north from Stockholm, is the small airport called Skelleftea. The planes from the capital city arrives here usually four times per day. Most of people who leave planes has a destination of their journey 30 kilometers to the west, on the Boliden area. Here, more than 85 years after the gold rush in this region, the

New Boliden company successfully continues the production of metals for the worldwide industry.

Important place in the Bolidens philosophy have innovations as a method to improve efficiency and, as one of a results, to increase profits. The company is the board member of IREDES initiative and has the right to take active part in works with the standard development.

The IREDES team had received an invitation from the New Boliden and on the beginning of October appeared in Sweden. It was a great possibility to discuss with specialists and to see modern mining supported by IREDES.

How do they use this?

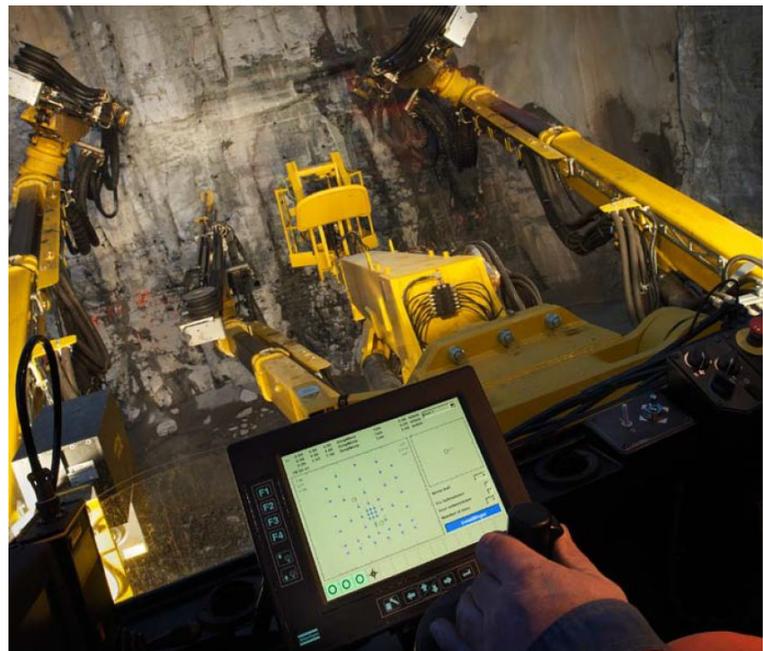
“We always need to know: how much does it cost and what can we get back” says Evgeny Novikov, the development engineer from Boliden. This strategy sounds carefully but is a good recommendation for technologies used in their mines.

In every mine appear questions and problems connected with drilling. How to drill exactly according to the plan with high automation? How to excavate only places where an ore concentration is the highest? Is it possible to collect useful data and measurements during drilling? How to get quick quality reports from the machines?

Since 2000 Boliden Mineral and Atlas Copco have cooperate to use the drill rigs more effectively. It has improved a system of map navigation by the drill rigs and onboard drillplan creation.

The New Bolidens mines use modern equipment with advanced IT systems. Atlas Copco machines are used for drilling and the special system was designed to have full control over the process.

In Boliden's underground mines Atlas Copco ABC (Advanced Boom Control) drill rigs are used. The device is able to work in 3 modes: basic, regular and total. The first one is in fact the manual mode. The

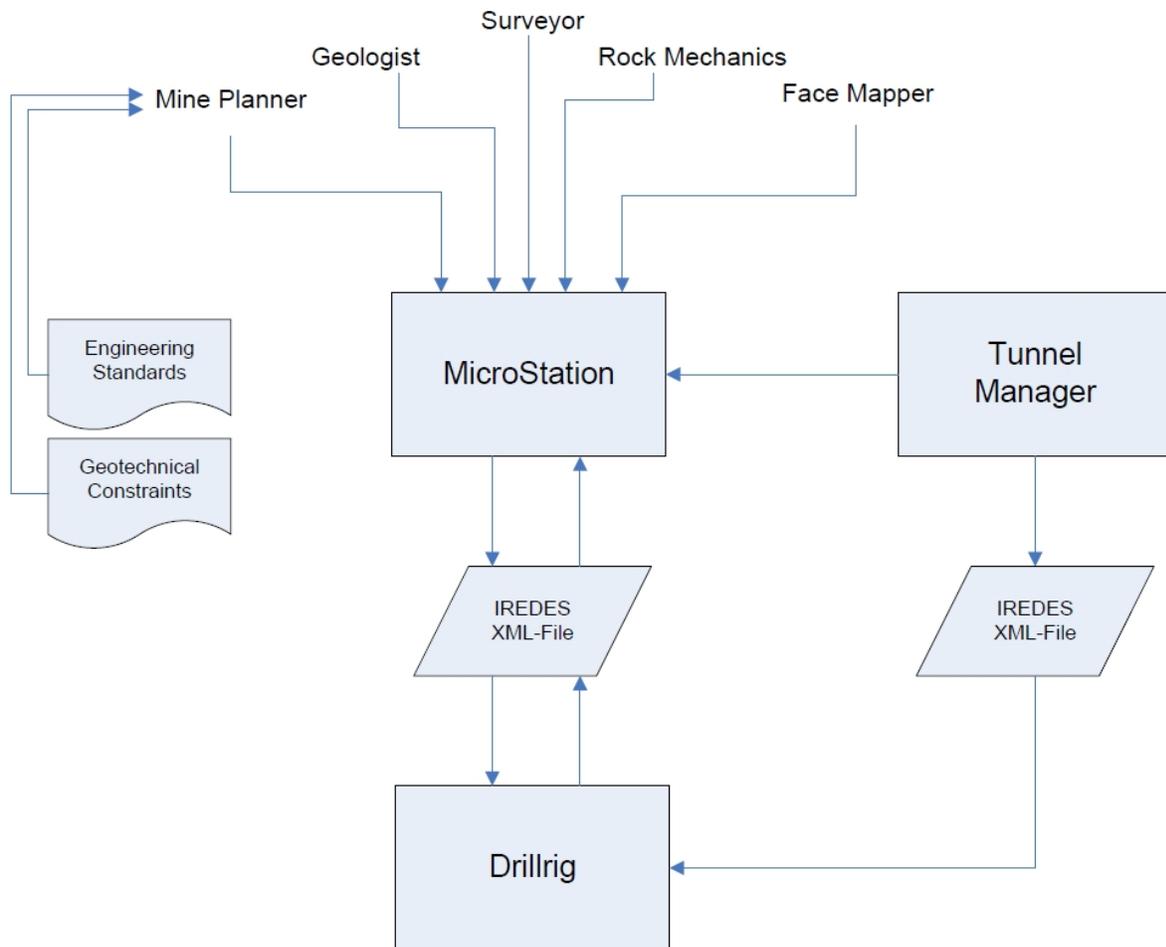


Atlas Copco drill rig with RCS

operators has data displayed on the control panel and controls the maneuvering of boom and feed. The regular mode offers semi-automatic drilling. The operator can position and direct the feed with the help of a predetermined drill plan. The total mode is fully-automated execution of a complete drill round. The operator only monitors the process. It is possible to switch between manual, semi-automatic and fully-automatic positioning and drilling, depending on the situation.

Most interesting are the modes which offer the biggest precision and automation. When the “common language” between machines is needed, the IREDES schemas are more than useful. The XML files are an interface between drill rigs and engineers, of course supported by software.

Boliden uses Microstation software to work with CAD files. In cooperation with Norconsult were developed several add-ons to Microstation to allow usage of IREDES schemas.



System overview

Based on engineering standards, geological and geotechnical information available, the mine planner prepares drill plan or suggested rule for drill plan creation to the design. It is exported from the software in the IREDES format and contains:

- planned mining volume
- mined volume
- geological interpretation
- mining areas or other object of interest in the vicinity
- face mappers latest interpretation
- coordinates for fix points (sidewall stations).

The other software – Atlas Copco's Tunnel manager is responsible for dynamic generation of drill plans for the drill rig.

Let's focus on the drill process everyday loop. On the beginning, the mine planner prepares a drill plan and upload it on a USB stick. Next, the driller operator takes it underground and puts it to the computer on the drill rig. The drilling round is automatically made according to this plan. During works, the on-board computer generates IREDES compliant MWD (Measurements While Drilling), quality and production files. All data are collected on the USB stick and goes back to the planning engineers. After analyzes, they prepare next drill plans.

Using an USB stick looks quite archaic and the next, natural step is to exchange them by WLAN communication. In fact, this will only change the transmission medium as the IREDES standard doesn't require a specific one.

What kind of data the drill rig collect? In general, there is information about time, hole status, average penetration, bolts, difference from the planned drill, feed pressure, feed vibrations and much, much more. Everything what may be useful for engineers to determine the properties and structure of rock, to prepare new drilling plan and to assess production performance.

Real-time visualization and process control is possible thanks to the display in the drill rig. It makes drilling a little bit like a computer game.

Where is the right point?

“We need the navigation to follow the geometry of ore bodies. We should know exactly where to excavate. Precision is critical” says Evgeny Novikov.

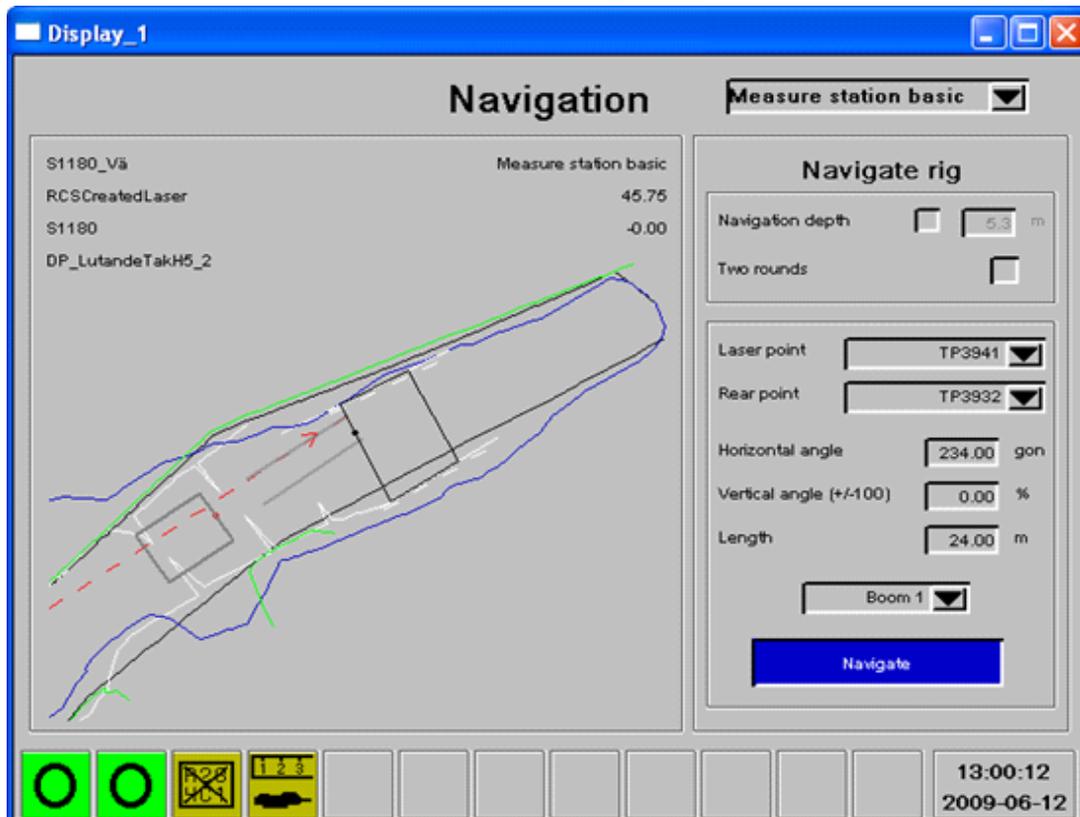
The navigation and orientation in the tunnel is not a trivial problem. Boliden uses Total Station Navigation. It provides fast navigation with accuracy better than 1 cm. All the system is built on the base of a laser teodolite and known fixpoints in the tunnel. One of the feeds is lined up in the direction of the laser beam. The angles and the distance are entered into the drill rig system. The position of the drill rig in the drift is shown on the rig display, including the locations in the face and the feeds.



To describe the coordinates in software, the IREDES Coordinate System is used. It is effective solution to import and export drills data in unambiguous way. The standard describes how different coordinate systems can be related and how to transfer the parameters between different kinds of equipment.

The navigation process is also visualized on the display. It has one big advantage – navigation is easier and new operators need less time to learn how to operate. From the technical point of view, this RCS' software interprets IREDES files (which contain data of navigation prisms) and show them on the screen.

In the future, the IREDES files could be transferred from drill rigs to the ground immediately. This allows the process control in real-time.

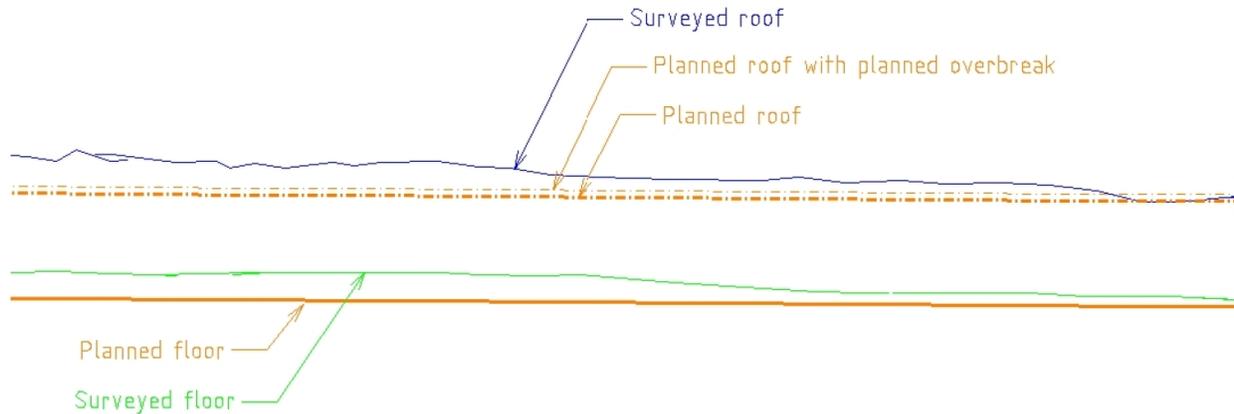


Navigation window in RCS

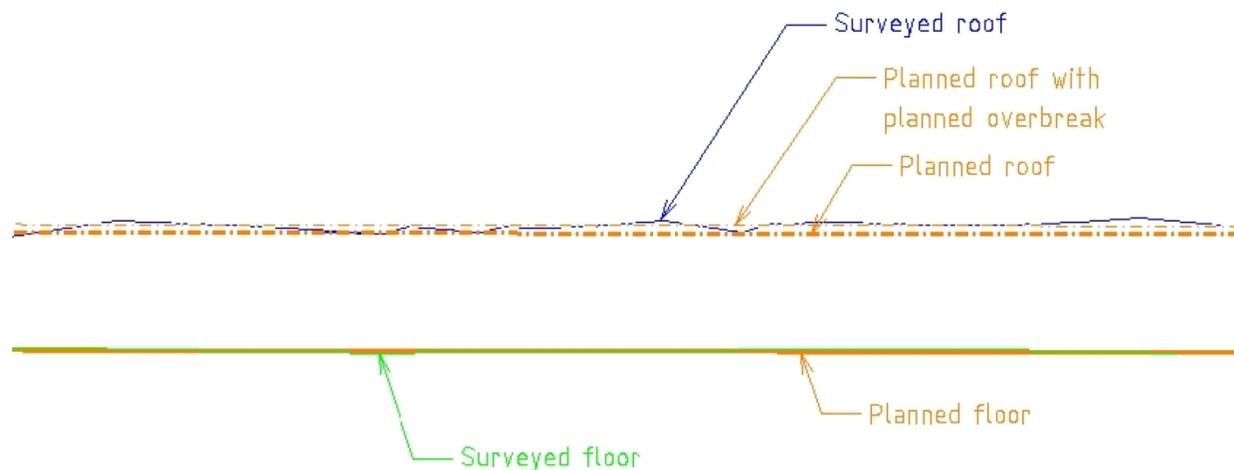
Business is business

“The benefit of using drilling monitoring is about few percents, but in fact, “few percent” means millions” smiles Evgeny Novikov. The pictures prepared by the Boliden allow to compare the difference with and without the monitoring and planning system.

Boliden does not have specific quality standards (in case of drilling) but it is necessary to minimize rework, reduce the damage zone and follow the plan as accurate as possible. Simple syntax and flexibility make IREDES a perfect weapon



The shape of tunnel without drilling monitoring and planning.



The shape of tunnel with drilling monitoring and planning.

It really works!

The effective cooperation between machines and human supported by software would be hard without IREDES. Due to fact that profile is developed by professionals, it perfect suits to demands of underground industry. It is also flexible - in case of new problems, it is easy to extend it.

New Boliden is one of the IREDES initiative board members and thereby contributes actively to create the future of the standard. That's the best way to customize this "common language" to their own requirements.

Thank you!

We are grateful to the New Boliden company, especially for Evgeny Novikov, Fredrik Ekenstedt, Fredrik Jonsson and Andreas Martensson. Thank you for your hospitality and time!

Sources:

The article is written on the base of:

- [1] Atlas Copco *Rig Control System* brochure
- [2] A. van Wagenigen, M. Andersson, K. Nystrom *Drill rig navigation and drill plan creation using IREDES*
- [3] Atlas Copco *Total Station Navigation* brochure
- [4] www.boliden.com