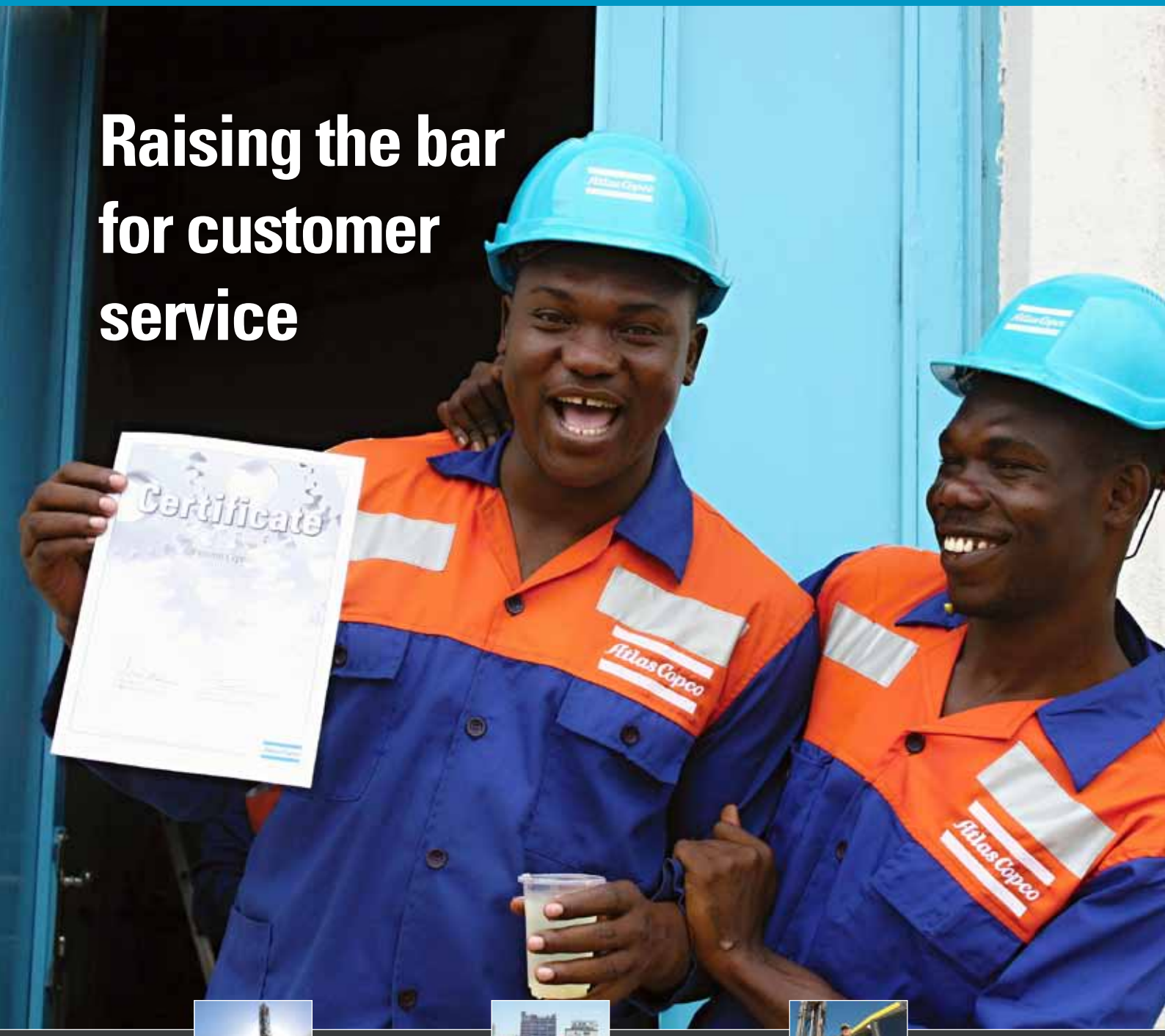
MINING & CONSTRUCTION

MECHANIZED ROCK EXCAVATION WITH ATLAS COPCO – NO 2 / 2011

Raising the bar for customer service



Atlas Copco

EDITORIAL

The mining industry is facing one of its biggest challenges in its history – how to attract and keep new talent to secure its future. It is a fact that we have experienced a very long period of global growth in education and living standards, and that's a very positive development.

The downside, however, is that due to increasing prosperity, fewer and fewer young people want to spend their working lives in a mine. These days they have other choices. That's why I am proud to say that Atlas Copco is making a contribution to the development of tomorow's mining engineers. Through our various training programs we are developing young, qualified service engineers every day around the globe as well as training our customer's personnel faster than ever, for example with the help of equipment simulators. We set our standards high. We demand discipline, a sharp mind, a professional approach and a good work ethic – and I am happy to say that the young people who apply to us to become Atlas Copco service engineers have all of these qualities and more.

This talent makes us an appealing partner for our customers and whenever a mine chooses us as a supplier they are also helping us to create more job opportunities and attract more young people to the business. It also enables us to prove that although mining may be a comparatively tough environment, it is a safer, more exciting and rewarding career alternative than ever before, characterized by mechanized equipment, modern mining methods and outstanding training techniques.

Sven Krarup
Service Manager, Atlas Copco Chilena.

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SPIRIT OF THE ANDES

The Chilean mining industry burst onto the world stage last year with the spectacular rescue of 33 miners trapped underground for more than two months. The courage and determination to succeed that was displayed by the Chileans impressed millions around the world. That same determination is being displayed again as Chilean mines lead the way in Latin America on the path to excellence in efficiency and safety. M&C samples the Andean spirit in action.

The Pit Viper 351 at work in the Radomiro Tomic Mine at 3 000 m in the Atacama Desert in northern Chile, known as the dryest in the world. Here, Atlas Copco takes care of all service and maintenance of the drill rigs.

Service priority at Radomiro Tomic

Codelco's Radomiro Tomic Mine in northern Chile has signed a 10-year service ageement with Atlas Copco that allows it to focus its attention solely on mining.

The Radomiro Tomic mine, known to the locals as "RT", has introduced a long term service solution that is expected to become a model for other mines. This mine, located at 3 000 m above sea level in the Atacama desert, has signed a 10-year agreement with Atlas Copco for service and maintenance of its drill rig fleet.

Atlas Copco has a service team of about 50 people on site taking care of 11 drill rigs including Pit Viper 351, ROC L8 as well as DMH and DML models. An additional three Pit Viper 351 drills are due to be delivered between the end of 2011 and the beginning of 2012, by which time the service team is expected to have increased to more than 60.

Eduardo Fajardo, Atlas Copco's administrator on the site, summed up the main reason for the mine's decision to outsource the service operation: "RT believes, as we do, that mines are designed to operate, not maintain."

Two programs in force

Two different service programs are in operation at the mine – a labor plus parts program (LPP) which supports pre-owned drill rigs and a maintenance and parts replacement contract (MARC) for all new rigs.

As the history of each part or activity of the used equipment is uncertain, it is not efficient to apply a fully comprehensive service program. Through LPP, the parts are provided by the mine and the labor is provided by Atlas Copco at a predetermined rate.

The MARC program, on the other hand, is a complete maintenance and repair service program that is applied to all new rigs as they arrive. A clear history can be tracked from the first hole drilled.

The contract consists of all maintenance and repair routines required to secure high availability and reliability. This includes preventive, planned and corrective maintainance as well as condition monitoring. All parts, repairs and labor required are provided by Atlas Copco at a guaranteed rate.

A predetermined performance level called Key Performance Indicators (KPI) has also been established using a maintenance balanced score card as a measurement tool. For example, it is expected that the Pit Viper rigs will be available 90 percent of the time. The mean time between failure (MTBF) is 44 hours and the mean time to repair (MTTR) is 3.5 hours. This translates to an average of 44 hours of straight operation before the rig is shut down for no more than 3.5 hours before it's up and running again.

Johnny Lopez, Atlas Copco service specialist, checks the performance parameters of the ROC L8.

Laid back: Operator Fernando Acuña finds automation relaxing as he waits for completion of the hole on his Pit Viper 351.

The ROC L8 gets a workout at the mine performing both presplit and production drilling.

The DMH, an older, used rig, has an availability rate of 78 percent while the MTBF is 29 and MTTR is 3.5. Each drill rig is covered by the contract independently and record keeping is meticulous.

The system requires considerable management expertise as well as technical skill and in this region Atlas Copco is well equipped to provide both. The service team is one result of the company's overall efforts in Chile marked by the creation of a Competence Development Center, hundreds of kilometers away in Santiago.

The onsite Atlas Copco team is divided into three categories; planning, execution and logistics. The planning team, the smallest group, works on short term and long term planning needs for parts and fluids. The execution team, the largest group, is dedicated to maintenance and repair tasks, while the logistics group is responsible for administration, warehousing and purchasing.

At any one time, Atlas Copco is responsible for 700 000 to 1 000 000 dollars in parts inventory (485 000 – 700 000 euros).

Eduardo Fajardo says: "The purchase of capital equipment is a small part of the overall demands at RT whereas having the qualified people to keep the equipment operational is a large part of the mine's success.

"As equipment becomes more technical and qualified labor becomes more difficult to hire, mines are looking to companies that can provide the total package."

Over the next year, the Atlas Copco Competence Development Center will have more than 100 skilled technicians at its disposal. Open pit and underground equipment specialists provide training in maintenance and skills in, for example, RCS, electronics and hydraulics.

The Center's mission is to develop every entrant into a master technician. "There are very few mining operations around the world that have a MARC program that come close to this," says Fajardo. "What we are doing here in Chile is very special."

Total focus on drilling

Fernando Acuña, an operator at RT, has ten years of drilling experience, and many more as a loader operator and truck driver. He says he enjoys his role as a driller, particularly as he is not responsible for maintenance. In addition, the automation of the Atlas Copco PV-351 gives him the confidence to relax behind the controls and he adds, jokingly, "this is a job for an old man!"

Acuña says learning to handle the computerized Pit Viper was not difficult and the rig keeps him informed of everything that is happening during the drilling process. He points to his rpm of 78 on the display screen and the indicator that shows him the penetration rate of 0.5 m per minute. Normally the rig operates at 1 m per minute and takes about 20 minutes to drill the 18 m hole with an 11 x 11 m burden and spacing pattern.

During M&C's visit, the rig was running with a weight-on-bit of 27 tonnes which is half of the 54 tonnes it is capable of.

The Radomiro Tomic mine, with an annual production of 300 000 tonnes of cathode copper, is now growing in the shadow of its big sister mine Chuquicamata, using the experience of its drill rig operators and the service and maintenance experience of Atlas Copco.

AUTOMATION at Escondida

Escondida Minera, a BHP Billiton property, is stepping up its investments in automation with Atlas Copco's rig control system (RCS).

With 1.4 million tonnes of rock and ore excavated each day and 1.3 m/t of copper processed each year, Escondida Minera is the largest copper producer in the world. It is a position that the mine management aims to maintain and therefore invests in first class operational systems and equipment.

Today, the mine operates 120 trucks, 18 shovels and 18 drill rigs and many of the processes are automated. Now the drilling operation is moving in the same direction with the recent introduction of Atlas Copco's Rig Control System (RCS) incorporated in a new fleet of Atlas Copco drilling equipment.

To meet its future drilling needs, the mine is phasing out its aging fleet of Bucyrus 49R electric rigs for a mixed fleet of Atlas Copco diesel rigs. The main production rigs will be the Pit Viper 351, of which two are currently in operation, but three DM 45, a DM-M2 and a PV-271 are also on site. Two additional PV-351 rigs are scheduled for delivery in the third quarter this year.

Escondida's growth plan emphasizes four basic principles: be safe, put people first, do things right the first time and think to the future. These are the principles that guide the management in developing the operation and planning of equipment purchases.

The drilling equipment must be mobile and offer autonomous capabilities both in the cabs and for mine planning.

General Operations Superintendent Hugo Reales Trigo says: "We look at every aspect of our operation, not just the mining, but things like where we get our water from, what will the mine look like in the future, and so on."

Escondida was opened in 1981 with a life expectancy of 52 years. Today, 30 years later, exploration and current mining technology has enabled the life of the mine to be extended by another 100 years.

"Growth to us means autonomous high production drilling," says Juan Carlos Fuentealba, Drill and Blast Manager.

The smaller rigs drill 200 mm holes while the PV-351 rigs drill with either 276 or 318 mm holes depending on the material. The benches are 15 m high with additional 1.5 to 2 m of sub-drilling.

The mine produces about 300 000 m per month from its two pits, Escondida and Escondida Norte, with the smaller drill rigs primarily drilling buffer holes. Two rows of small diameter holes are used between the production holes and the final pit slope to optimize rock fragmentation. At Escondida,

The Pit Viper 351 working in the Escondida pit.

"Automation is tied to safety and everything we do has a safety procedure attached to it."

Hugo Reales Trigo, General Operations Superintendent

Tight team at Escondida: Hugo Reales Tiego, Drill & Blast Superintendent and General Operations Manager, Juan Carlos Fuentealba, Drill & Blast Manager, Miguel Alarcón, Blasting Specialist, Nelson Trejo, Atlas Copco Chile's Sales Manager, Omar Allel, Atlas Copco's Regional Manager, Latin America, José Seleme Drilling Specialist, José Torres, Senior Drilling Supervisor and Alvaro Roco, Blasting Specialist.

Atlas Copco ROC L8 rigs are used for pre-splitting work.

The mobility of the PV-351 is a key contributor as it moves from bench to bench and pit to pit. The Pit Viper can also be moved with the tower up, or with a "live-tower" on the bench, something that could not be done with the old fleet. "We leave the tower up if the drill has to tram less than 600 meters," says Senior Drilling Supervisor Jose Lorre. "In addition, as Escondida expands, we will have a third pit in the near future and mobility will be even more important."

Production in the pits has also increased, mainly due to the new rig's availability, and the penetration rate is better, too with the Pit Viper compared to the fleet that the Atlas Copco rigs are replacing.

As the mine moves forward, the management is also enthusiastic about using the new training simulator that the Atlas Copco Customer Center is providing. "We like the idea of using a simulator because we won't take a drill out of production for training purposes," says Reales Trigo, "and it would also be very expensive if a drill became damaged.

"The young guys adapt to the technology well. It's complex, but they like it. Having hands-on training is a big benefit and the simulator training is safer too as it keeps people off the bench."

GPS navigation

A big advantage of the Pit Viper for Escondida is the rig's GPS navigation capability. This allows the drill pattern to be located via computer and downloaded to the rig's onboard computer. All operational data is also stored to make the rig's performance and service record easy to monitor.

Overall, the Pit Viper rigs have lived up to expectations since the startup. "We had no problems commissioning and we went right into production with the first rig," says Reales Trigo.

He adds that the biggest benefit of the new fleet is automation. "Automation in drilling is tied to safety. Everything we do has a procedure attached to it for safety reasons, which takes time. By incorporating automation into drilling, many time-consuming safety procedures are either eliminated or reduced."

He concludes: "Safety means reducing hands on equipment and keeps people off the ground and that's what we all want – to have the safest operation possible."

Ambitious target at Esperanza

Esperanza is ramping up to become Chile's next big mining operation. Here, rotary drills for production drilling and DTH rigs for pre-splitting is the method of choice.

The Esperanza mine in the Antofagasta region is a young mine with big ambitions. Opened in 2008, the first blast took place in March, production drilling got under way in July of 2009 and it is now fully operational with a daily production target of 420 000 tonnes.

As a new mine, Esperanza has also had the opportunity to adopt the most modern mining practices right from the beginning.

The mine plan is to operate three pits over an area 1.2 km long and 97 m wide with a depth of 140 m. The main metal is copper, but the ore also yields gold and molybdenum. The mine operates two electric and two diesel shovels. The electric shovels are used in waste while the diesel shovels are used in ore. The practice is to drill 16 m holes with a 1.5–2 m subdrill. The drilling pattern depends on the type of rock being drilled.

For safer pit slopes, an Atlas Copco ROC L8 drills a line of 165 mm holes along the wall for presplitting. The blast creates a clean crack between 2 m spaced holes. The line is drilled 2.8 m from the closest blast pattern holes.

Blasting manager Claudio Herrera said, "The presplit line can be shot anytime, immediately or to start off the blast." Almost all of the benches are presplit for safety reasons and especially when near a haul road.

A buffer zone is drilled next in the pattern which keeps the full impact of the main blast from transmitting its full energy into the wall.

This consists of a double row of 170 mm holes drilled with two Atlas Copco DMM3 drills. The buffer zone is shot after the main blast with only a slight delay. The DMM3 rigs are also used for production drilling when necessary.

The majority of the production drilling is carried out with four Atlas Copco Pit Viper 351 rigs drilling 170 mm holes in ore and 310 mm holes in waste.

The reason for choosing the PV-351 was for its weight in relation to hole size, pattern size and bench height, but also because of its advanced technology. The mine is familiar with previous generations of automation on

> I feel I can get more done with this rig. Positioning is faster, it tells when the jacks are fully up and it's safer too.
>
> Herman Gospochetic, Drill Rig Operator, Esperanza.

Operator Herman Gospochetic at the controls. Bottom right, the Pit Viper 351 drills 270 mm holes in ore and 311 mm holes in waste.

Atlas Copco blast hole drills and has since converted to the latest version equipped with the Pit Viper's Rig Control System (RCS).

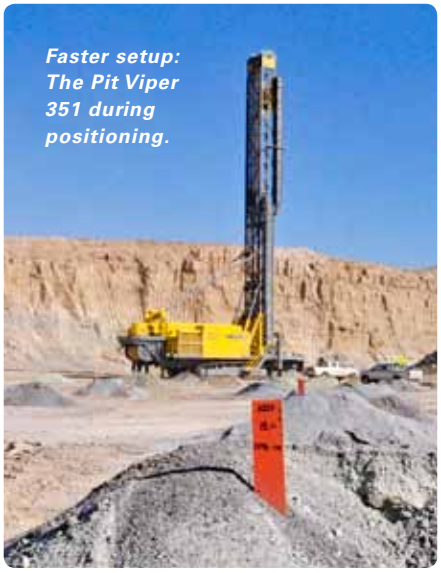
Jorge Alberto Saavedra, trainer on the new RCS-based Pit Viper rigs, says "The operators have picked up quickly on the new model and find it much easier to run. It's faster to set up on the hole and the controls are closer at hand, which also makes this rig easier to operate."

Operator Herman Gospochetic agrees. "Positioning is much faster with RCS and I feel I get more done," he says. "The remote control upgrade on the system is also more user friendly."

Gospochetic also feels he can be more accurate, "more detailed" with the new RCS system. "I think it's safer too. For example, it tells me if my jacks are up completely. The older rig system we used could not show what it was doing like the Pit Viper RCS machine."

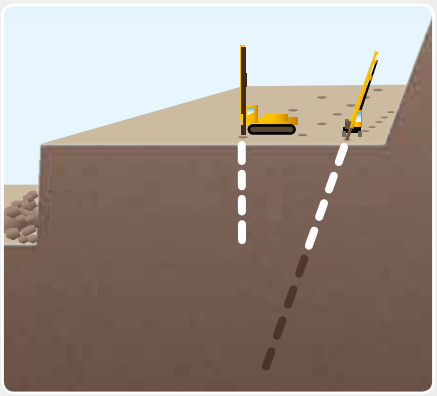
This willingness to embrace innovation is also in line with the mine management's strategy for developing the mine. "Water consumption is a good example," Herrera points out. "This is the driest desert in the world and we have to get the water for mining from the sea, 125 kilometers away. To do this, we pump water at 760 liters per second to an altitude of 2 300 meters. This system shows how we want to do things in an innovative way at Esperanza."

Esperanza is at the beginning of its life. With modern methods and equipment it is aiming for a long and prosperous future.



Faster setup: The Pit Viper 351 during positioning.

Typical sign: In mines where the drilling of the final slope is performed with drill rigs that are not suitable for presplit drilling the result is an unstable pit wall and benches that crumble and collapse over time.



Ideal solution: Small, versatile ROC rigs take care of the presplitting work, often drilling two benches at the same time, while large rigs such as the Pit Viper drill the production blastholes. This results in a relatively undisturbed pit wall with less shattering, rock movement and damage.

Visible evidence: The fact that the drill hole marks can be clearly seen proves that presplitting has been properly executed with closely spaced, straight and parallel holes, blasted with light charges ahead of the buffer and production holes.

A BETTER WAY to presplit

Presplit drilling is common practice in open pit mines around the world but the results often fall short of expectations. The soluton is optimization using a unique combination of drill rigs to form the perfect presplit partnership.

By Mario Santillan Product Manager Surface Drilling Equipment

Presplit drilling is nothing new. It is widely used around the globe and generally accepted as the standard method of creating safe final pit slopes for open pit mining. At the same time, there are many mines that could take advantage of the huge savings that can be gained by optimizing this operation using modern presplitting technology.

Perfect partnership

When it comes to blasthole drilling, large hole drill rigs such as our Pit Viper series drills coupled with our FlexiROC D60/65 and SmartROC D65 crawler rigs, is without doubt the smartest partnership.

The Pit Viper is used for drilling the production blastholes and the FlexiROC D60/65 and SmartROC D65 are used for drilling the presplit holes. Working together, these rigs are able to achieve outstanding results – and there is plenty of evidence to prove it.

At the Chuquicamata mine in Chile, for example, pre-splitting with ROC L8 rigs has been in operation for more than 10 years. It started with a fleet of two rigs drilling around 25 000 m per month. The concept proved beneficial and the operation has now grown to more than 100 000 m per month, carried out by a fleet of 20 rigs operated by the Chilean presplitting service contractor Servicios Mineros.

In Australia, the presplitting specialist Rock Australia provides these services to mines all over the country using a fleet of about 10 rigs including ROC L8 and SmartROC D65.

Meanwhile in Sweden, presplitting is a major part of the operation at the Aitik mine with ROC rigs doing the presplitting work and Pit Viper rigs taking care of the production hole drilling. Here, 165 mm presplit holes are drilled at 20 degree angles on 33 m double benches. The holes are spaced 1.8 m apart and are fired just ahead of the blastholes. By the way, Sweden and Australia also lead the way towards greater productivity using our SmartROC platform.

It is easy to see that these mines all have one thing in common – presplit holes that are perfectly straight and parallel, slopes that are close to the planned angle of the final pit wall and benches that are smooth and stable.

Unfortunately at other mines, the opposite is a common experience; presplit holes that take off in different directions, a lot of waste rock that has to be blasted and hauled away at great cost and uneven slope walls that crumble and collapse over time.

Large rigs versus ROC

Often I find that mines with poor slope stability tend to use their large blasthole drill rigs for both production and presplitting and this is not cost-effective. Large rigs such as the Pit Viper series are excellent

Model of efficiency: At the Aitik mine in Sweden the SmartROC D65 drills a row of presplit holes 33 m deep at an angle of 20 degrees (from the vertical). The SmartROC also drills the first two rows of production holes nearest the presplit holes. The first of these "buffer" or "helper" holes are drilled 15–16 m deep at an angle of 16 degrees while the second is drilled 10–11 m deep at an angle of 10 degrees. Both presplit and helper holes are 165 mm in diameter.

for production drilling and although they can be used for down-the-hole (DTH) drilling up to 229 mm (9 inch bit dia.), they are not intended for presplitting.

Such machines are oversized for this application which makes them difficult to position in a tight spot in order to drill a row of parallel, closely spaced pre-split holes. In addition, the angle drilling option on the Pit Viper only allows the tower to be tilted backwards in increments of 5 degrees and the diameter of the holes they drill are too large for the small charges of explosives required in order to obtain a good result with the presplit blast. Also, when the drill has to be moved to another bench, this can take a long time to prepare, especially for the electric powered version.

Small, flexible ROC rigs on the other hand, such as the ROC L8 series and SmartROC D65, are specifically designed for presplitting. They are much more flexible and can drill a variety of angles on a very narrow berm with great precision. For instance, the ROC L8 is only 2.5 m wide, it can drive on the berm and also drill sideways at an angle of 32 degrees or more.

Versatility = accuracy

As the stability of the rock in an open pit mine determines the slope angle, and stability can vary from area to area, the resulting slope angles for the pit wall are not always in round figures. They could be 18, 23 or 27.5 degrees, which is why a presplit rig must be very versatile. The Atlas Copco rigs are specially designed so that the feed can be fixed at fractions of an angle. But performing presplitting on fixed angles such as 5, 10, or 15 degrees from the vertical, as is the case with the production drills, clearly makes it more difficult to follow the open pit design.

With ROC rigs, presplit holes can always be drilled as planned. Furthermore ROC rigs are not just better at presplit drilling, they can also be used for a variety of other tasks such as leveling benches for the large rigs, complementary drilling of buffer holes up to 203 mm, drilling long, horizontal dewatering holes or using the Reverse Circulation (RC) option for in-pit grade control.

The newer SmartROC D65 has taken these capabilities to an even higher level with the hole navigation system (HNS) which helps the operator to locate the right spot without having to mark the holes, auto-alignment of the feed to align the holes correctly and find the right direction and angle for collaring. It can also use a wide range of hammers for optimum drilling between 110 mm and 203 mm. And all this combined with full drill cycle automation which practically reduces the operator's job to supervision.

A fleet consisting of large drills and ROC rigs is, in my view, the most optimal presplit and blast hole solution on the market. And in these tight economic times when it is important to keep operating costs at rock bottom, this is one area in the mining process where fortunes can be saved.

At the same time, it should be remembered that this is not just about money. It is also a matter of creating a safe working environment which is equally or perhaps even more important. Safety has always been priority one in open pit mining. Creating safe pit walls at the desired angle is a must for a safety-conscious operation.

BENEFITS OF "ROC" FOR PRESPLITTING

- Straight, parallel holes
- Exact positioning of the holes
- Wide variety of hole dimensions
- Small size and easy to manoever
- Small explosive charges for best results
- Can perform a variety of tasks in the pit
- Boom positions the feed in all directions

Mario Santillan is Product Manager, Atlas Copco Surface Drilling Equipment. Based in Sweden, he is a mechanical engineer with a background in mining in Latin America.

THE UNDERGROUND OPTION

A solution to the quality of big city life

As the world's cities become increasingly overcrowded, the quality of city life continues to decline. Big city planners are more and more aware that something has to be done. But what? For **Gunnar Nord,** Atlas Copco's senior advisor in tunneling, the solution is both obvious and inevitable. Go underground.

By all accounts there will soon be seven billion people living on planet earth and the experts believe this figure is likely to rise to more than 10 billion by the year 2050.

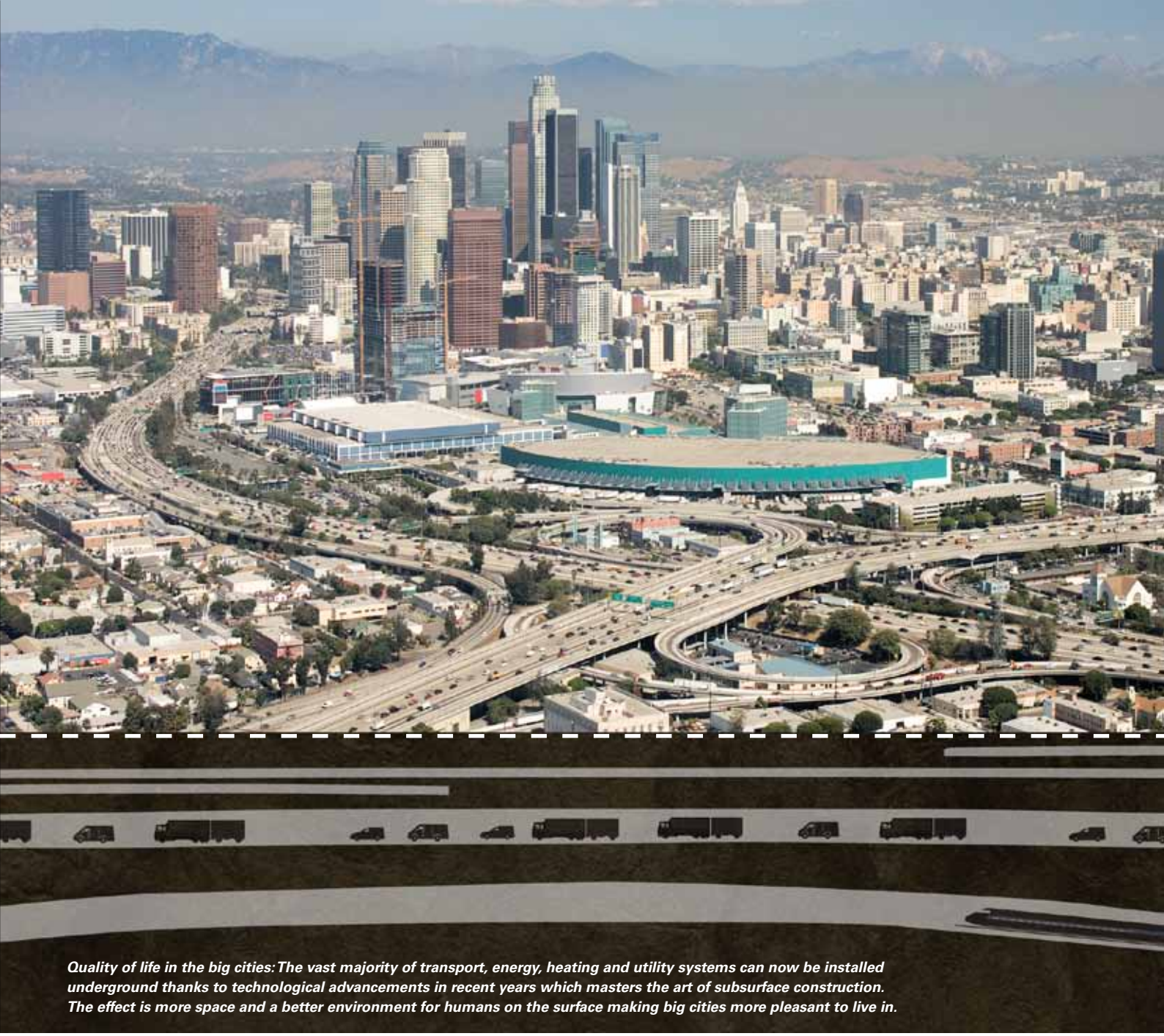
The numbers are, in themselves, not especially alarming. But the rate of migration to the big cities of the developed world will make it increasingly difficult to sustain the quality of urban life.

More people means more accommodation, transportation, food and energy supplies, clean water, health, education and so on. All aspects of society will be tested to the limit. How the big cities will cope with a population explosion over the next 50 years is a question that faces politicians, urban planners and citizens alike. And it's a hard one to answer.

But if you ask Gunnar Nord, Atlas Copco's most experienced specialist in underground structures, the answer comes back without a moment's hesitation. "We have to do more to exploit the space beneath our feet. We have to go underground to a much greater extent than we do now – and we have to do it fast."

Sub-surface space is commonly used for drinking water tunnels, sewage systems, district heating plants, subways and telecommunications and few have witnessed as many developments underground in one career than Gunnar Nord. For more than 35 years he has traveled the world to advise on the installation of tunnels for roads and railways, power stations, rock caverns for oil storage depots, and the like. Today, he is convinced that the solution – or at least a major part of the solution – to preserving the quality of life in big cities is to prioritize investment in underground construction.

"It's astonishing to me that we continue to build road systems on the surface," he



Quality of life in the big cities: The vast majority of transport, energy, heating and utility systems can now be installed underground thanks to technological advancements in recent years which masters the art of subsurface construction. The effect is more space and a better environment for humans on the surface making big cities more pleasant to live in.

says. "More highways mean more vehicles which mean more noise and more pollution. Especially when you consider that we have all the technology we need today to build these road systems underground.

"It's the same with parking lots, railways, power lines, power stations and utilities. By placing as much as we can below ground, we will get them out of sight and free up precious building land for housing, green areas and more pleasant surroundings for people to enjoy. It's all about planning in order to secure a reasonable quality of life in our big cities in the years to come. That's something we all want and need but are in danger of losing."

Ten mice too many

Nord likes to draw on a well used analogy; two mice in a box can live in perfect harmony. Add another ten mice and the result is chaos. In the same way, a massive increase in urban populations can undermine big city life. Land, housing, transportation, health care, energy supplies and other necessary services all come under pressure.

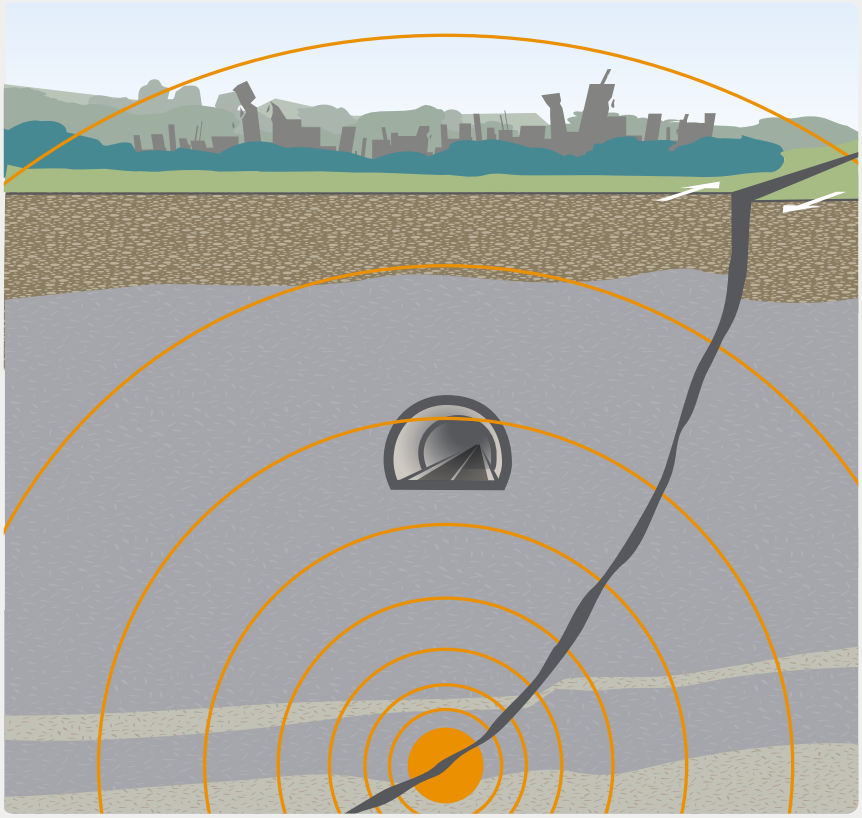
"It's time for decision-makers in the developed world to seriously consider locating as many installations and facilities as possible below the surface from now on," he says. "I believe it is the only way forward if our cities are to remain habitable beyond the next half of this century."

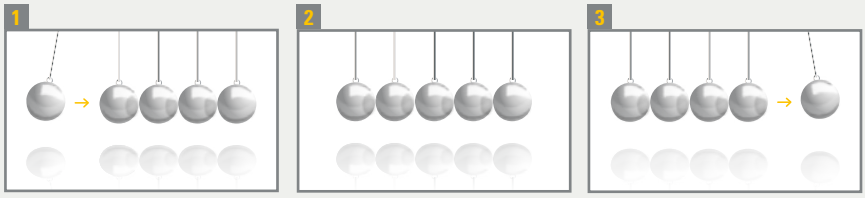
Some decision-makers are listening, however, and the practice of "going underground" seems to be increasing. From complex road projects in Germany, Sweden and Switzerland to new railway networks in the U.S. and giant storage caverns in China, underground space is being exploited more than ever before.

Typical examples of how sub-surface space is being used to advantage include the new city bypass systems in Stuttgart and Stockholm, Chicago's tunnel and reservoir plan (TARP) which is being built for drainage water management and the new underground railway line at New York's Grand Central Station.

Despite the trend, Nord says much more can be done. Electricity cables, power and water cleaning plants, storm water run-off systems, oil and gas storage facilities and even archives or libraries, such as the one in the center of Stockholm are all candidates for location underground.

"It makes perfect sense to get every facility underground that does not have a real »





When the earth moves: As demonstrated by Newton's cradle above, the release of impact energy can pass through a structure from one side to the other with a minimum of disturbance to the center. Gunnar Nord is convinced that underground installations, such as road tunnels and nuclear power plants, are safer and that the impact of seismic activity can be minimized. Right, traffic in big cities continues to threaten the quality of life but road tunnels like this one make a big contribution to a better urban environment.

good reason to be on the surface," he says, "particularly now that we have the technology and the experience to do so." In this regard, the advancements made by Atlas Copco in computerized drilling techniques cannot be overstated. This has made a huge difference to high-speed, high-precision tunneling so that the task of locating installations underground, a power plant for instance, has become both easier and less costly.

"The advantages of this are huge," explains Nord. "If you build a nuclear plant underground it will be much safer from earthquakes, terrorism or other attacks and if radiation leakage occurs it will be easier to contain.

"I am convinced that if the Fukushima plants in Japan had been underground they would not have sustained so much damage from the tsunami and it would not have developed into such a disaster. In fact, they may not have been damaged at all."

As a specialist in rock mechanics and underground construction, Nord knows better than most how rock behaves when it moves. To illustrate the way impact energy travels he refers to the famous Newton cradle. This device shows that when one ball in the cradle is lifted and released, the impact energy travels through the line, hardly moving the center balls, until it reaches the last ball at the opposite end of the cradle. Here, the full force of the impact is suddenly released, propeling the ball outwards. By imagining the cradle turned on its side, it is easy to perceive how the release of energy deep in the earth – an earthquake – will pass right through a structure, affecting it mainly at the entry and exit points.

"Displacement caused by the movement of rock on a fault zone, for example, can easily be taken care of using special shock absorbers to protect a structure," says Nord. "This principle has been used to protect tunnels built on or near a fault zone."

The 2.9 km long Mount Bolu tunnel in Turkey, part of the Trans-European Motorway linking Ankara and Istanbul, is a case in point. It was built in the mid 90s using Atlas Copco equipment and at a point where it crosses the North Anatolian Fault. The design is based on articulated blocks, 60 cm thick and 4.40 m wide with 50 cm gaps in between which, in the event of a quake, will allow the tunnel to move in an articulated manner without collapsing.

Nord continues: "Our long experience of rock mechanics and the technology that exists today enables us to build virtually anything we want underground; factories,

shopping centers, hospitals, you name it." At the same time, he concedes that there are obstacles. Not all countries or sites have sufficiently competent rock formations to support underground installations and the cheapest alternative often takes priority in city development programs.

Yet these arguments are fading fast. He adds: "We have ways of dealing with unstable ground now so that's not a very big problem today and the cost of constructing underground is much more favorable nowadays. In the 1960s, it was estimated that the cost of building a nuclear plant underground was only five percent more expensive than building it on the surface – and it's probably even less today."

Considering the advantages to society of underground construction, that's probably a price worth paying.

Extensive career underground: Left, Gunnar Nord inspecting a collapsed irrigation tunnel in Venezuela in 1982 and, right, at the portal to a road tunnel in Japan in 2006.

Gunnar Nord

Reflections from a life in rock

After gaining a Masters degree in civil engineering from the Royal Institute of Technology in Stockholm, Gunnar Nord embarked on a career which became a lifetime in rock.

He started at Skanska, one of Europe's largest construction companies, where his knowledge of rock mechanics secured him a position in the company's planning division, mainly dealing with underground works.

For almost two decades he consulted at construction sites around the globe. He returned to Sweden to run the company's consultancy department for underground excavation in soil and rock, but then felt the urge to move on.

He joined Atlas Copco, first as a consulting engineer for Jarva and Robbins tunnel boring machines (TBMs), working out of the U.S. and Sweden and when this was divested he moved on to conventional drill and blast tunneling.

Reflecting on the changes he has seen over the years, he says: "To my mind, the most important development has been the creation of a working environment that will attract new people."

There's no doubt, he points out, that modern drill rigs are a world apart from their predecessors in terms of ergonomics, operator comfort and safety. "If we still had the kind of technology we had back in the 60s and 70s it would be very difficult to get people to work underground. With the modern machines we have today which are clean, safe and comfortable, it is a lot easier."

The second major development is computer controlled drilling systems. "This has made tunneling equipment much easier to use, more accurate and more economical. Modern rigs can also perform at far greater speeds than were available in the 70s and 80s, with superior percussion rates, movement between holes and accuracy in drill steel positioning. Not only that, today's machines feature built-in intelligence. The rig can measure the increasing torque and make the decision by itself to pull out."

Another area where Atlas Copco rigs excel is the size of the tunnel cross sections they can now reach. The popular three-boom rigs vary from 137 m^2 for the Boomer EC 3 to 198 m^2 for the Boomer XE3 C. The Boomer XE4 C, on the other hand, will reach a section of 205 m^2 using four BUT 45 L booms, each equipped with a COP 3038 drill for blasthole or grout hole drilling.

But it is not only Atlas Copco drill rigs which have improved. The entire spectrum of equipment for drill and blast has changed, too. Atlas Copco's trucks, loaders and surface crawlers are now all computerized and the company's rock drills are extremely powerful and efficient.

Nord points out: "In the 1960s we only had cross bits and chisel bits. When we learned how to get the button bits to stick into the drill heads we saw a real improvement. They've been a great success and have allowed us to drill much longer holes when needed."

A corresponding improvement in detonators and explosives has also played a role in the success of the drill and blast method, especially in urban areas. Here, the trend is towards electronic detonators which ensure that each hole is detonated in a pre-set, delayed pattern.

Says Nord: "Vibration is generated by the amount of explosive detonating at the same time. If three or four holes blow simultaneously you'll get a much bigger vibration. Electronic detonators are so exact that each hole will detonate by itself so only that portion of the explosive will affect a building. Electronic detonators are more expensive but by using them you can increase the volume of the blast and the length of the pull drastically, so it becomes more economical."

All these improvements have dramatically changed drill and blast technology, making urban underground projects a more attractive and economic option.

For more than a decade, Australia's Donnelly Blasting Services has been one of Queensland's most successful drilling and blasting contractors. Now the company is looking forward to even more sunny years ahead with two new Atlas Copco drill rigs in its fleet.

Consistency and reliability: Both PowerROC T35 rigs average 300 m per day for DBS in two separate Queensland quarry sites.

Queensland sun sh

Leading Australian contractor lifts his hat to the new surface crawler

Donnelly Blasting Services (DBS) became the first drilling and blasting contractor in Australia to acquire Atlas Copco's new PowerROC T35 surface crawler rig. The company has added two of these rigs to its fleet, clearly confirming that the new model meets its rigorous demands.

Based in Tamborine, Queensland, DBS has a fleet of 13 drill rigs and some 20 drillers serving the quarries and construction sites of Australia's renowned Sunshine State. In order to improve productivity and efficiency for its customers, it decided to expand its fleet with the PowerROC T35. The two rigs were delivered on March 11 this year and were up and running just three days later on March 14.

Managing Director Jason Donnelly says the reliability and performance of this tophammer production rig is as consistent as the Queensland climate. "We're averaging 300 meters a day with these rigs," he says. "and the key is the consistency. Our average drilling rate is up and whereas some other machines will get 250 meters one day and then 350 meters the next, this rig has just gone out and consistently done the meters every day. That's important to our bottom line." Another advantage, says Donnelly, is that the team was able to get the rigs operational almost immediately. "They didn't take months to set up and tune in. Basically they just rolled off the truck and have done what Atlas Copco said they would do."

He continues: "When we know something is going to take two days to get drilled and not two-and-a-half because you might have a good day one day and then the machine just doesn't get the meters the following day – it impacts our scheduling and scheduling is obviously key to that bottom line."

Variety of assignments

Besides drilling and blasting at quarries, DBS has also worked on a number of dams and other construction projects and the company expects that to continue. "We work on a variety of projects so we're always doing something different," says Donnelly. "We bought the PowerROC T35 rigs as part of our ongoing fleet upgrade and we are using them to drill 76 to 102 mm blastholes, typically up to 20 m deep.

"We saw that the smaller rigs could outproduce bigger rigs and that's what has

Good point: Managing Director Jason Donnelly, left, says the new drill rigs are "better on fuel, better on price and the operators like the simplicity".

A question of confidence: Driller Russ Schmidt:"It's comfortable and the set-up in the cabin is excellent."

ines on PowerROC

happened. They are better on fuel economy, better on price, and the operators like the simplicity of these rigs. We appreciate the reliability and also the back-up we get from the supplier." He adds that the two PowerROC T35s are currently working at separate quarry sites and getting the same positive results.

Straightforward machine

At Mount Marrow near Ipswich, experienced driller Russ Schmidt said the results over the past two months using the PowerROC T35 have been impressive after more than 290 hours of drilling.

"It's a very straightforward machine – there's not a lot to go wrong – but it's also extremely smooth, easy on the running gear and it's capable of doing just an enormous number of meters," he says. "On my previous rig (of another make) if I was going as hard as I could in a shift I could maybe get 220 meters in a day. This effortlessly does 300 to 320 meters a day, and if I spend ten hours in the rig I'd do over 350 meters.

"It's comfortable and the controls and set-up in the cabin are excellent – and I'm six foot tall and 120 kilos. Also, the diesel consumption compared to the amount of meters you get is fantastic."

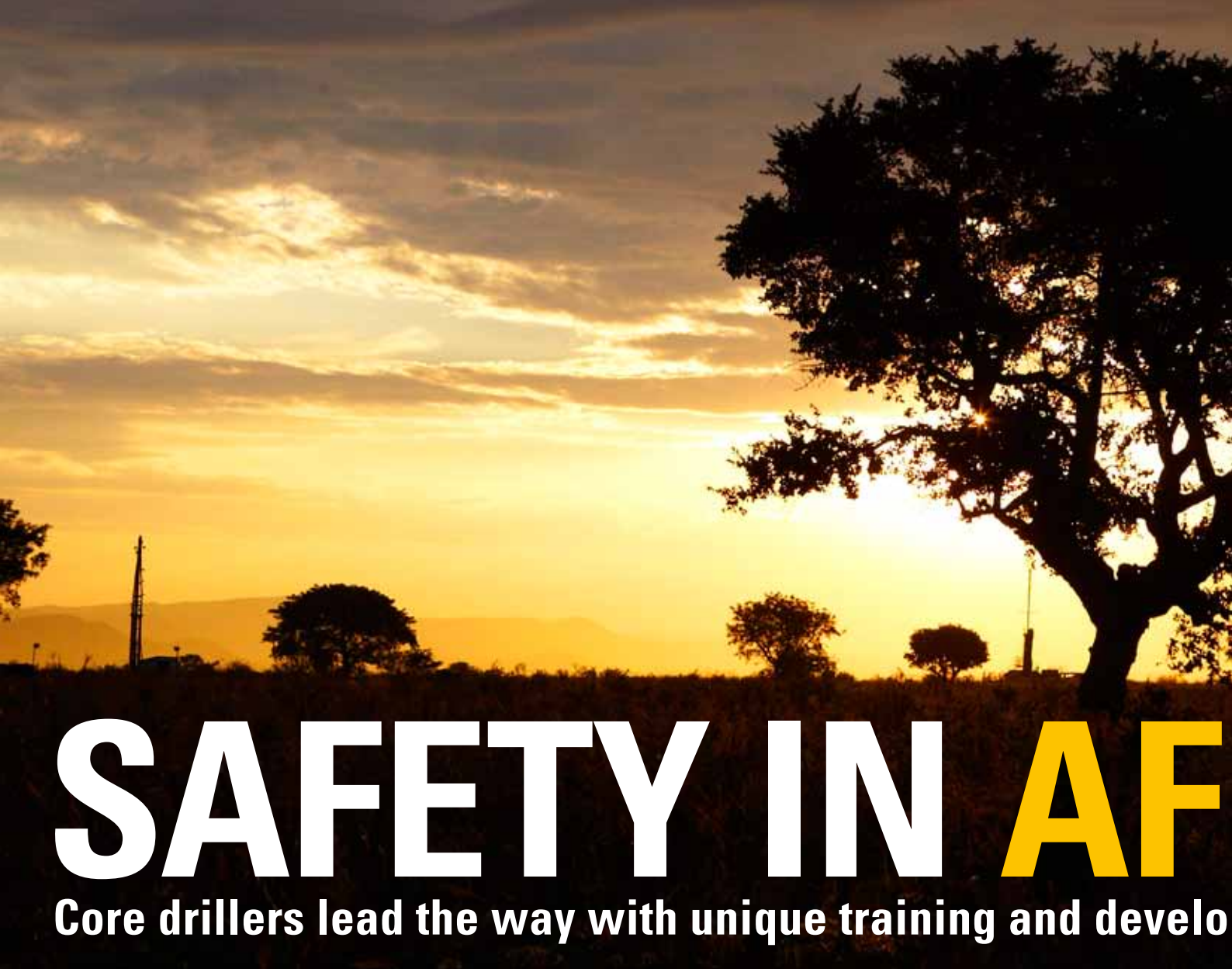
Schmidt, who has been with DBS for about five years, says quarry drilling can be harsh on equipment, rods and shanks.

"I've probably done over 9 000 meters on the rods," he said. "The last shank did 127 percussion hours and I probably could have got another 20 out of it. I like to have one sort of half worn as back-up in case one snaps. The performance so far has been unbelievable. You have to see the rods to believe it.

"As far as running costs go, these rigs are probably streets ahead of anything else I've used. With the life that I've got left in the rods now, I wouldn't be surprised to see them do another 5 000 meters. With other rigs I've had, 8 000 to 9 000 meters is pretty much about as good as you get.

Using COP 1840EX rock drills (18kW drill power output) and T45 rods, a 142 kW Cummins engine and CF90G5 screw-type air compressor, the PowerROC T35 typically drills 64–102 mm holes down to 25 m.

Atlas Copco says the rig's feed system optimizes rock drill performance while the proven COP 1840EX combined with the advanced drilling control system copes with the toughest rock conditions.



SAFETY IN AF

Core drillers lead the way with unique training and develo

A South African core drilling company is rapidly making a name for itself as a leading campaigner for increased safety in the African drilling industry thanks to a unique training program coupled with equipment and support from Atlas Copco.

Like many African drilling companies, there was a time when Zaaiman Exploration Drilling prioritized profitability. Today, the company has a somewhat different approach to business: a total commitment to safety as the key to success.

"It's a complete turnaround for us," says General Manager Flip Roux. "We were one of those companies that thought safety was a bit of a burden. Then about five years ago, after an accident involving some of our people, we came to the conclusion that safety was actually the key component to profitability and further development."

It was a realization that completely changed the company culture. Zaaiman started by developing its own internal training courses for drillers. With support from Atlas Copco with regard to drill rig design and operating procedures, this effort has now evolved into a full-fledged qualification program that is unique in South Africa and formally recognized by the South African Qualifications Authority (SAQA). In addition, Zaaiman plans to make the program available to other drilling companies around the country.

A family-owned company, Zaaiman is based in Witbank, 130 km north east of Johannesburg. It is able to perform core drilling operations anywhere in Africa but is currently focused on the South African provinces of Mpumalanga, Gauteng, KZN and Limpopo. It has 43 fully equipped core drilling rigs in operation including the world's largest fleet of new Atlas Copco Christensen CS series.

In this mineral-rich area, the company

> "The qualification program has changed the whole perception of drilling among our employees.

Flip Roux General Manager, Zaaiman Exploration Drilling

RICA

pment program

Safety first: The Atlas Copco Christensen CS14 core drilling rig at work in Mokopane.

serves clients such as Anglo Platinum and Platreef, Ikwezi Mining and BHP Billiton, as well as a string of coal mining companies including Total Coal, Anglo Coal and Xstrata Coal.

Far-reaching implications

M&C asked Flip Roux to explain the philosophy behind the company's safety strategy and the implications for Africa's drilling community.

"Safety is becoming more and more important. It concerns our people, the environment and the places where we work. It became obvious to us that in order to raise standards we needed to offer our people a qualification system which goes hand in hand with safety. If you've got a properly skilled and qualified person then naturally that person is less likely to make mistakes.

"At our own training center we have now developed two qualifications and we are busy developing even more. We are currently the only drilling company in the country »

On a career path at Zaaiman: Core driller Happy Makwana at the controls of an Atlas Copco Christensen core drilling rig in Mokopane.

Team spirit: Each member is taught to do things correctly and safely to protect each other and the environment.

that is able to present formal drilling qualifications for its people, and for our drillers it makes a huge difference. They are very excited about it because it means that drilling is no longer just a job, it is something that is becoming a proper career. We have set the drillers on a clear career path which will help them to grow and develop in the drilling community.

"They can do certain parts of the course right away and then add to it, right up to the point where they have a formal qualification and they can 'fly'. After that, they can grow into the next qualification and the next."

A new perspective

This safety-first approach has changed the perspective of drilling among Zaaiman's drillers, says Roux. "Previously, if someone offered one of our drillers another 10 Rand on their salary it was purely a financial decision. Now they stay with us – not for the money – but because of the opportunity they have here to grow into the industry, to develop as professionals and be acknowledged.

"Every person that gets a certificate on the way to a formal qualification is a very happy person. They know they are doing the right thing. This is not like being told to do something. It is something that has been designed for their benefit, something they can learn from and which actually gives them something in their hand that they can use. They can go to another company, present their qualification and say 'this is what I have done and this is what I still need to do in order to be the best driller I can be'.

"But it's not only qualifications that matter. It's also important to us that we can prove that our people are properly trained not to cause harm to themselves, their colleagues or the environment."

Safety is teamwork

Zaaiman rig operator Happy Makwana is a team leader on the company's Atlas Copco Christensen CS3001 rig and embodies the new attitude among the company's drillers.

"Safety for me and my team is everything. When you start work at 6-oclock in the morning you have to be sure that every member of the team knows what to do. We have to be able to rely on each other to do things right. Anyone who can't work safely as part of a team will not get a job here.

> "We know that here we will grow and grow and never fall."
>
> **Happy Makwana,** exploration rig operator

"We feel proud to be employees here because we know that we will develop and grow and grow and never fall."

"It is also important to show that we can work in a responsible way and help the company to improve every year. We want to be the top one in this business."

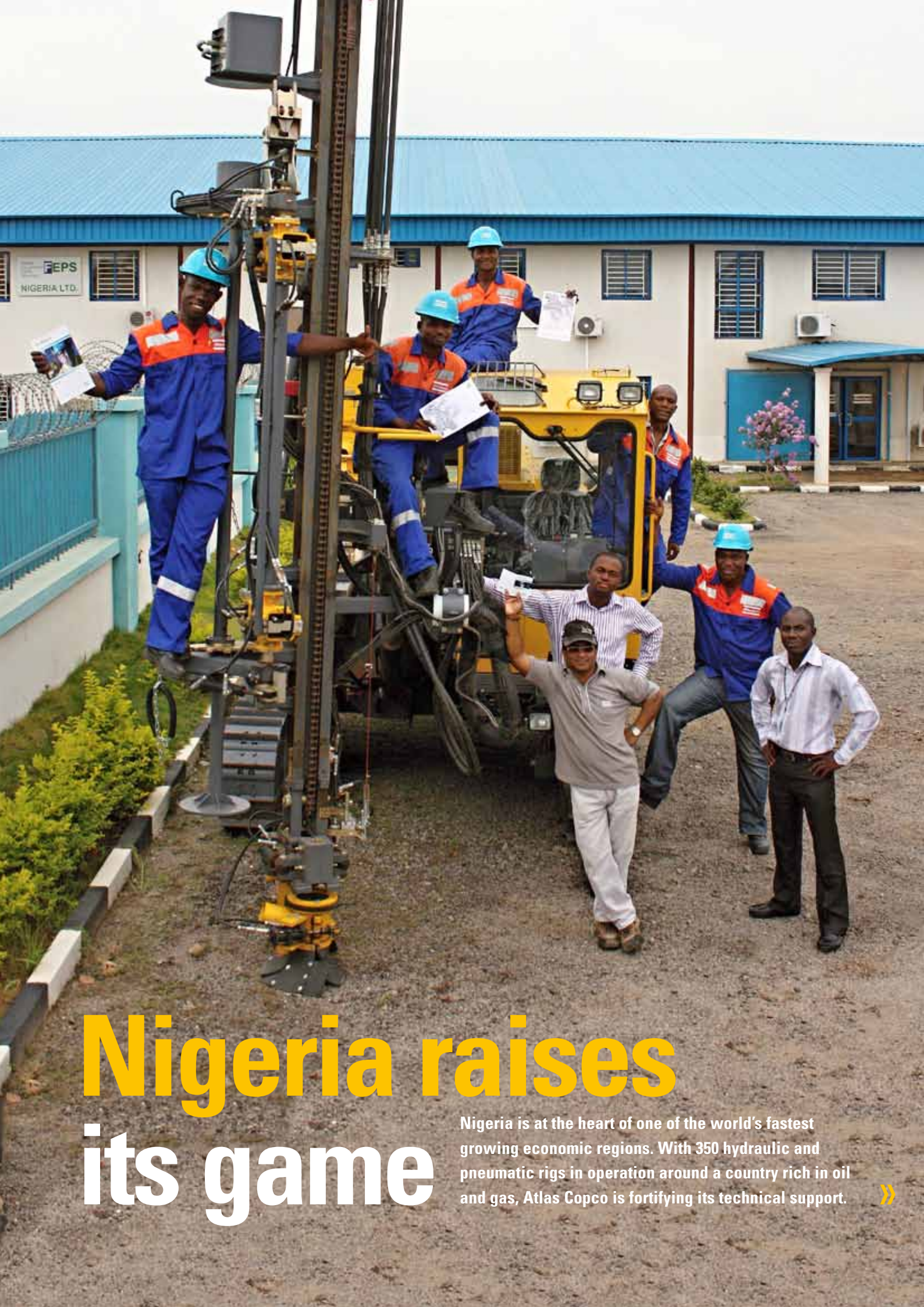
He adds that the Atlas Copco Christensen rigs also play an important role. "The Atlas Copco machines are one hundred percent safe," he says. You don't have to deal with heavy things with your hands or your feet. On some machines they have something called a footclamp where you have to use your foot to hold it open. With the Atlas Copco machine you just use the levers.

"It's the same when you have to add a rod or tube, you don't have to use your hands like other machines, you use the winch. Depending on the rig. You can add nine, six or three meters, whatever you want using the winch. Also, the winch and other parts have protective guards so you can move around freely without worrying about catching your clothes or injurying yourself."

Profitable strategy

The strategy is also paying off for Zaaiman. Says Flip Roux: "Our staff turnover is in single figures and our lost time through injuries is low. Our drilling teams are totally committed to safety and can be relied on and we are improving our drilling figures on a daily basis. It has also put us in a position where we can now train operators at other companies in southern Africa and I think that will soon become a major part of our business."

He concludes: "Safety is definitely profitable. Sometimes it might feel like a bit of a drag, but if you do it properly and make sure that all your people do the right thing at the right time and do not get hurt in the process, it will benefit the whole business."



Nigeria raises its game

Nigeria is at the heart of one of the world's fastest growing economic regions. With 350 hydraulic and pneumatic rigs in operation around a country rich in oil and gas, Atlas Copco is fortifying its technical support.

Competence in progress: Trainee service engineers in Nigeria get acquainted with the capabilities and characteristics of the Atlas Copco Mobile Workshop.

Nigeria is the eighth largest country in the world with an estimated population of 150 million people and the capital, Abuja, is reportedly one of the fastest growing cities of the world.

Driving from the airport to the downtown area, the scenery is frequently adorned by drill rigs, crushers, pavers and rollers – equipment that is engaged in an ever-increasing number of infrastructure projects in and around the city.

Abuja is certainly booming but so are many other parts of this country that is rich in natural resources such as oil and gas. Atlas Copco Nigeria currently has around 350 drill rigs in operation in the region of which most are pneumatic but also some 70 hydraulic rigs. Having access to high performance equipment is essential. Equally important is having access to high quality technical support and competence development is therefore a top priority.

Training for excellence

This year, Atlas Copco Nigeria launched an effort to raise the standard of support at the Parts and Service department. Primarily, this meant increasing the knowledge base and boosting efficiency.

Says Patrik Rylander, General Manager at Atlas Copco Nigeria: "We have developed fantastic drill rigs and other equipment and now we are further boosting the competence of our service technicians in order to meet our customer's expectations for speed, quality and service excellence."

Atlas Copco runs a three-step certification program for all service technicians. After each course, participants are required to pass tests in accordance with requirements set within the Atlas Copco certification program. The program got under way in Nigeria in March and focuses on hydraulics and electrics.

To ensure safety and strengthen emergency procedures is an integral part of the program with a course on how to administer First Aid and CPR in the event of an onsite accident followed by general life saving instructions. This was attended by all staff at the Atlas Copco Customer Center.

Trainer Andreas Ahnlund of Swemox Solutions, a company that assists Atlas Copco with First Aid courses, says: "Just a basic knowledge of First Aid can make the difference between life and death in an emergency situation."

Knowledge for life

Venkatesan Chandrakumar, Parts and Service Manager at Atlas Copco Nigeria says: "This training is not only used when working for Atlas Copco, it also provides knowledge for life. It emphasizes safety and the environment which is first in mind for us and also benefits our customers."

One customer that has noticed a change at Atlas Copco is the engineering and construction company Triacta Nigeria which acknowledges an improved service standard with increased knowhow among the Atlas Copco technicians.

Walid Chakhtoura, Managing Director, Engeering and Purchase of Triacta Nigeria says: "Today I am more than pleased as there has been a total change in efficiency and quality of service. It has now decreased our downtime and increased our productivity. "

A life changing EXPERIENCE

Mohammed the van driver becomes Mohammed the service engineer

Van driver Mohammed Zubairu joined Atlas Copco on August 10, 2009. It was the day that changed his life. He is no longer a driver. He is a full fledged Atlas Copco service technician with customer responsibility.

When Mohammed Zubairu drove to the Atlas Copco premises for the first time, little did he know that it would be a life-changing experience. Zubairo was a truck driver, working for a contractor that was carrying out maintenance work on the building. He was looking for a change and when he heard that Atlas Copco needed a part-time driver he applied for the job and got it.

His task was simply to drive the service engineers to worksites – and then drive them back to the depot again when they had finished their work. But that wasn't enough for the ambitious Zubairu. Instead of waiting in the service van and perhaps taking a nap to pass the time, he followed the engineers to the worksite. He watched closely as they carried out service and maintenance work on drill rigs, making a mental note of every routine and also assisted by handing the engineer the required tools and spares.

Three months later, Zubairu's initiative and enthusiasm came to the attention of Parts & Service Manager Venkatesan Chandrakumar. Firstly, he upgraded Zubairu to the status of Permanent Service Driver which would enable him to improve his knowledge of service work in the field and waited to see what would happen. Before long it was clear. With reports for good work coming in from technicians as well as customers, Chandrakumar offered Zubairu the opportunity to be part of Atlas Copco's service technician trainee program.

It was the offer he had been waiting for. Today, Mohammed Zubairu holds a level one certificate and has moved on to the next phase of his development, the level two Pilot Certification Program recently held at the Atlas Copco competence center in Örebro, Sweden. He no longer drives engineers to customer sites. He is a full member of the Nigerian service team who is himself driven to the sites, meets the customers and carries out the work.

Atmosphere of continuous improvement

For the 37 year old Zubairu who is married with three children, life has changed dramatically. Speaking of his experience to M&C he said: "It is fantastic, a dream come true for me and my family. I never thought I would get this opportunity and I owe it to my managers who always encourage us and want us to improve. It has been a great journey for me and has lifted me up in the eyes of my closest neighbours and colleagues. This is what I have been trying to achieve my whole life and now it has been put in place."

When it comes to the future, he has no reservations about his personal goals. "My first goal is to make Atlas Copco first in mind and first in choice. Secondly, I aim to be one of the best technical engineers and troubleshooters on the Atlas Copco team."

Parts & Service Manager Venkatesan Chandrakumar added: "We are very pleased for Mohammed. He certainly deserved this position and is doing well, contributing to the growth of our company."

Proud moment: Mohammed Zubairu, service technician with Atlas Copco Nigeria shows his qualification certificate with Parts and Service Manager Venkatesan Chandrakumar.

OLYMPIAN A

In a few years, a Russian resort on the Black Sea will be thrust into the international spotlight when it hosts the 2014 Winter Olympics. To prepare for the big event, the town and surrounding area is undergoing a huge infrastructure upgrade.

The Russian city of Sochi has some stunning features – a subtropical Black Sea coast, snowy Caucasus mountain peaks and forests teeming with wildlife. It is also the scene of the largest infrastructure project in Europe as it prepares to host the upcoming 2014 Winter Olympics.

This massive undertaking is largely divided into two clusters – one in the mountains and the other along the coast. The ice events will take place in the coastal cluster which features the Olympic Park incorporating the Bolshoi Ice Palace, the Maly Ice Palace, the General Stadium, the Figure Skating and Short Track Center, Speed Skating Center, Curling Center and media villages.

All the skiing and sliding sports will take place in the mountain cluster in the Krasnaya Polyana mountains including the Cross-Country Ski and Biathlon Center, the Russian National Sliding Center, the Alpine Center, a ski jump complex and the Snowboard Park and Freestyle Center. In addition, a total of 47 transport projects are under way including the airport, roads and railways with Atlas Copco equipment used in almost every aspect.

All of the projects have to be completed within very constrained timeframes and in compliance with international standards for quality, energy efficiency and environmental responsibility.

Drilling meet expectations

Construction of the main passenger route between the airport at Adler and the mountain resort of Alpika Service, is a typical case. This is a single track railway which runs along the Mzymta River to carry trains

> “We are really impressed by the machines’ high productivity and precision.
>
> **Sergey Polukhin,** Technical Director, Bamtonnelstroy.

CHIEVEMENT

in both directions. There will also be a two-lane road running parallel to the track.

Here, Bamtonnelstroy, one of Russia's biggest construction companies specializing mainly in the design and construction of underground structures, is in charge.

The company is using a fleet of Atlas Copco drill rigs including five Boomer XE3 C, three Boomer 282 and two Boltec L2. The equipment is said to have met all expectations with all work completed on schedule due to high productivity.

Sergey Polukhin, Chief Engineer at the time of M&C's visit and now Technical Director, says: "To complete the entire scope of work in time it is essential for us to have the latest innovative technologies. That's why we chose Atlas Copco. Another reason was the extremely complex geological conditions of the Caucasus mountain area.

"We started the Olympic project fully equipped with Atlas Copco machines and were really impressed by their high

Olympic task: An Atlas Copco Boomer XE3C tunneling for contractor Bamtonnelstroy.

An Atlas Copco mobile service container near one of the road tunnels outside Sochi. Atlas Copco provides round-the-clock service support for the contractors as well as operator training, equipment start-up, technical consultancy, inspection and diagnostics, all with the aim to achieve zero downtime.

Well qualified drillers: The Boomer operators like Yuri Bogdanov are all trained by Atlas Copco.

productivity and precision. The Boomer rigs for example allow us to reduce time in preparation work by 80 percent and drilling speed and the quality of the works increased dramatically."

The project includes a road bypass to decongest the city's streets, 15 bridges and five tunnels with a combined length of more than 10 kilometers. New road systems will connect sporting and tourist venues to make travel convenient for both participants and guests of the Games.

In the mountain region, the work is mostly performed in unfavorable weather conditions with heavy rains, snowfall and fluctuating temperatures. Nikolay Strugovshikov, Chief Engineer of the Russian construction company Mosty y Tonneli (Bridges and Tunnels) says: "When you are high in the mountains in remote regions like this that are difficult to access, equipment reliability is the first priority."

Bamtonnelstroy's Sergey Polukhin adds: "Our drill rig operators get special training from Atlas Copco, and the certification is a requirement to work with the high technology equipment we have.

"It is also essential for us that we get well organized service. Atlas Copco has on-site service engineers who are always present and ready to assist. Consumables and spare parts which are necessary for continuous operations, are also readily available from Atlas Copco in Sochi."

Russia's leading infrastructure developers and construction companies are at work throughout the Sochi area and many of these are using Atlas Copco equipment.

Responsible games

All the construction work is being carried out according to the highest standards of quality, energy efficiency and environmental impact. Alexei Shishov of Mostovik, a design and construction company tackling many of the Olympic projects, says: "For me personally, as a Sochi native, preserving our unique eco system is of the utmost importance. As the head of the construction company, environmentally responsible construction is a must and it is our obligation to use ecologically efficient technologies and materials. Apart from its reliability and energy efficiency, the Atlas Copco equipment helps us minimize the negative impact on the environment as it meets the highest environmental standards."

Putting Sochi on the world map

Sochi (pop: approx. 400 000), located on the Black Sea coast, is already a well known resort attracting some three million tourists every year for health treatment and leisure. After the 2014 Olympics it aims to become even more popular as a destination for sports, recreation and business. It will be first time that Russia hosts the winter Olympics and the project is a long-term investment in the development of the entire southern region. Besides new, modern transportation systems in and around Sochi, the region will benefit from increased energy capacity and the development of some 200 new business and entertainment centers.

Full marks in Sweden: David Rohlén of Rohléns Sprängtjänst put the new SmartROC T35 to the test at a quarry north of Stockholm.

MEETING THE BIG THREE

Contractors give top marks to new SmartROC T35 in five countries

Atlas Copco's new crawler drill SmartROC T35 has scored points for the three most important demands in today's surface drilling industry – low fuel consumption, increased productivity and high availability.

Low fuel consumption, increased productivity and high availability is the magic combination that drilling and blasting companies are looking for – and the new SmartROC T35 meets all three expectations.

According to field tests in five countries, the new rig consumes as little as 10 to 15 liters of diesel per hour (under favorable conditions) and that is said to be half the fuel consumption of other comparable rigs on the market.

The SmartROC T35 also scores well for increased productivity and availability which further contribute to lower costs and better overall economy.

Rohléns Sprängtjänst AB of Sweden tested the rig for about three months in the Malmen quarry, north of Stockholm, where it was used alongside three other Atlas Copco rigs, two SmartRig ROC D7C and a ROC D7.

"The rig was in operation for 40 hours a week during the test period and it worked really well," reports the owner David Rohlén. "There was a dramatic reduction in fuel consumption and a clear increase in productivity from the very first day.

"We have been using ROC D7 rigs since they were introduced in the 1990s. It has always been good, but the SmartROC T35 is a great improvement. A lot of things have been upgraded or changed and Atlas Copco has done it in the right way, especially when it comes to the design of the controls which makes this rig much easier to operate."

New platform

The SmartROC T35, which features Atlas Copco's rig control system (RCS), has new hydraulic systems, a Tier 4 engine which meets all current emissions regulations, coupled with a cabin that is said to be the most modern of its kind with the latest in ergonomics and comfort.

Rig Design Manager Jimmy Holler says: "We started by developing a new platform for the control system at the end of 2006 and energy optimization was the goal. The result is that the operator can now adjust the capacity of the flushing air and the dust collector simply by pushing buttons. The RCS control system also makes sure that you get full hydraulic power at lower revs than previously and the engine is controlled in a way that makes it much more effective and efficient."

Besides reducing fuel consumption by 50 percent, CO^2 emissions are also reduced by 25–30 kg per engine hour, giving long-term sustainable productivity.

The SmartROC T35 and the larger T40 are designed for drilling and construction as well as quarrying. The T35 is equipped with a COP 2540 rock drill as standard with the COP 1840 as an option. It can tackle all types of rock in the hole range 64–115 mm.

MONEY T

"Sustainability" is a popular word nowadays and in the mining industry it is often used in connection with the future. However, at a recent international conference Atlas Copco's Lars Bergkvist told delegates that sustainability is already within the grasp of every mine on the planet.

TO BURN?

Mining companies looking to achieve long-term sustainability goals do not have to look far. Neither do they have to invest huge sums of money to get results. Instead, the key components of sustainability are already close at hand and just waiting to be discovered.

That was the message from Lars Bergkvist, Atlas Copco's Senior Advisor Mining, when he recently addressed delegates at SDIMI 2011, the International Symposium of Mining Engineering held in Aachen, Germany.

This event brought together mining engineers from around the world to discuss the efforts required to achieve sustainable operations.

Bergkvist took the opportunity to challenge the common belief that sustainability is a major undertaking and pointed out that at some mines, sustainability is simply a case of "good housekeeping" – in other words, better resources management. Back in Sweden, Bergkvist elaborated on his views for M&C readers.

Easier than many believe

"The term 'sustainable mining' refers to an operation that is run so efficiently in good times that it has the stability to survive and prosper over the long term, including during down periods. It naturally follows that a sustainable mine is one that is also sustainable from an environmental point of view, which is an equally important goal.

"Unfortunately, there are many mines that are far from achieving this level of sustainability. Either they are too busy meeting demands during the current boom so they don't have time to address the issues, or they believe that it is such a big issue, requiring a lot of time and investment that they push it into the future. It is also very common for a mine's purchasing strategy to focus more on price than on the total cost of a system with all parameters taken into account.

"In my view, sustainability is easier and quicker to achieve than many companies think. The answer lies in the use of resources and the potential for savings through increased efficiency."

War on waste

While many mines may exercise outstanding control over the way they use resources such as water, compressed air and electricity, he maintains that others are not taking full advantage of the available opportunities for improvement.

"Take water and water retention, for example. Water is primarily used for flushing drill holes to bind cuttings and dust particles but also for increasing productivity. The greater the speed of the rock drill, the greater the need for water.

"The cost of providing and retaining water constantly increases, partly because of increased consumption by individual drilling units, but also because of mining at greater depths where transporting water upwards requires more powerful pumps and more energy to drive them.

"There is great potential here for discovering intelligent solutions such as Atlas Copco's water mist system, a mixture of incoming flushing water and air which can reduce the need for flushing water by up to 80 percent. Compressed air is also expensive but it is still worth considering.

"In addition, large volumes of water are often pumped over long distances at high cost and this can be changed by recycling the water closer to the worksite."

The way compressed air supplies are arranged is another area that needs close attention, Bergkvist maintains. Often the air is supplied from a fixed installation on the surface and is delivered into the mine by running galvanized pipe bolted together every five meters, usually along the walls of the ramp or in a shaft. This pipe system can be up to several kilometers long with great risk of leakage from the joints.

Lars Bergkvist: You don't have to look far to see where huge savings can be made.

"I know of cases where probably half of the compressed air just escapes along the way and goes to waste. Even the best system can lose about 30 percent," he says. "Imagine a 1 000 meter deep shaft mine with a one kilometer pipe down the shaft. That's 200 joints in the shaft alone, not to mention all the joints that run to every production area. But there is a solution here, too. Install the compressors under ground, close to where the air will be used. This will reduce leakage and the cost of the electricity needed to drive the air such long distances."

A better way to ventilate

While diesel operated equipment has raised productivity in mining, it has also increased the need for ventilation and this often accounts for the greatest unit cost for power. Bergkvist explains: "Some mines are losing fortunes in ventilation costs because they »

Leaking money: Compressed air pipelines that sometimes run for several kilometers in a mine are usually bolted together every five metres with a subsequent risk of leakage from the joints. The longer the pipeline, the greater the risk. Even the best systems can lose about 30 percent says Lars Bergkvist.

allow these systems to operate at full flow at all production points at the same time, even in areas where no mining is taking place.

"By only making ventilation available in the areas where it is needed, the consumption can be reduced significantly – in other words, ventilation on demand. This can be done by regulating the air flow frequency in the ventilation fans. Frequency control provides ventilation only where it is needed and closes it down in areas that are lying dormant.

"Ventilation is also a question of reducing fuel consumption and the amount of exhaust gases to be ventilated. Our RCS computer controlled loaders reduce fuel consumption by 30 percent and can provide data on the ventilation requirements of each unit – a function that is performed automatically, communicating with the ventilation system online."

As the price of oil and electricity is expected to remain high in the future, all mines will have to consider their energy costs when deciding what equipment to buy. Cable lengths, for example, can be reduced by up to 90 percent by drilling so-called service holes for installing electricity connections in the rock instead of in existing drift systems. Atlas Copco Robbins 34 RH, which is primarily designed for raiseboring, can also drill high precision pilot holes for service holes of 254 mm up to 610 m in length.

"Reduced cable length means less disruption and reduced risk of damage to the installations by large vehicles in tight spaces," says Bergkvist. "If damage does occur, causing a power failure, all or part of the operation has to stop while the damage is repaired, with costly disruption to production ."

Total process optimization

Bergkvist concludes: "Increasing productivity for our customers is the foundation for all of Atlas Copco's business activities. But we are also committed to sustainable productivity which means we always take the long term view. Our customers need to know that they will be productive, not just today or tomorrow, but a year or even ten years from now.

"An underground mine is a process system with many different unit operations that need to work together to achieve optimal conditions and by bringing monitoring to a higher level it provides an opportunity to optimize the entire value chain.

"It's a question of achieving total process optimization and with today's modern equipment and communications systems it is now easier to get an overview by gathering selected data.

"I believe it is time to focus on the totality that is required in order to achieve the best overall solution."

Footnote:
Mining engineers will get a chance to hear Lars Bergkvist at the 22nd World Mining Congress due to be held in Istanbul, Turkey September 11–16.

Good news for all Pit Viper operators:

A NEW CAB IS BORN

The new cab design for the Pit Viper 270 series has improved safety features, greater visibility, flip-up buddy seats and a better insulated A/C unit.

Atlas Copco has introduced a new cabin for the blasthole drill rig Pit Viper 270 series to go with the latest Rig Control System (RCS) technology which comes as an optional feature.

The cab is larger than the previous model and offers a number of ergonomic and safety features to increase productivity. Greater visibility is offered with larger windows, an excavator style chair that sits on an elevated platform and a more robust set of windshield wipers.

Ease of maintenance is a key component of the cab with integrated lights in the cab's profile that prevent having to climb onto the cab to service. The air conditioning unit is located under the cab and the A/C compressor, evaporator and condenser are all hydraulically driven.

The A/C unit is better insulated to ensure that the cab stays much cooler than the previous model and the fitted floor mats, integrated into the cabin, assist with keeping the cab clean.

There are also three buddy seats that flip up to provide extra storage and these can be replaced with other options such as a refrigerator, locker and/or microwave.

One of the buddy seats can also be upgraded to a trainee seat that comes with a backrest and seatbelt assembly. This way, drillers in training will learn how to operate the RCS technology in a safe, ergonomic working environment.

For more information, visit www.atlascopco.com/blastholedrills or www.RCSPitViper.com.

The Pit Viper 270 combines RCS technology with ergonomic design.

Comfy workplace: The new cab for the Pit Viper 270 series is specifically designed with the operator's well-being in mind.

Dynamic hammer takes the lead

Multi-purpose COP 20 DTH hammer

The new COP 20 down-the-hole hammer is the latest member of the COP family. Aimed at construction work such as ground reinforcement and anchor bolting, this new DTH hammer is ideal for 70–89 mm diameter holes in difficult ground conditions.

The COP 20 is a truly multipurpose DTH hammer where small diameter holes are needed. It is ideal in quarrying and mining as well as the dimension stone industry (DSI), civil engineering and exploration drilling.

Reliable performer

Thanks to the valved air regulation and lighter piston, this hammer offers excellent penetration rates compared to its predecessors. Having combined the best features of previous models with the latest DTH technology, COP 20 offers excellent reliability while operating at 7–12 bar. The hammer's proven check valve and spring combination means better protection from external water and cuttings and optimum functionality.

The proven six-splined BR2 bit shank comes without an exhaust tube. This unique feature adds to the reliability of the hammer by avoiding downtime due to exhaust tube failure. There is a comprehensive range of COP 20 drill bits available from 70–96 mm in diameter.

Braving the occasional rainstorm, industry professionals showed great interest in the broad range of Atlas Copco equipment on display including the ROC T15 crawler (top left), underground equipment such as Boomer rigs (far left), the intelligent SmartROC D65 (right), mobile crushers, Unigrout grouting equipment and much more.

Showtime at Atle quarry

Sweden reveals latest developments for industry professionals

Mining and construction professionals from some 20 countries traveled to Sweden recently to explore the latest technology and glimpse the future with Atlas Copco.

The Swedish town of Örebro, headquarters of Atlas Copco's mining and construction divisions, was the venue when industry professionals traveled to Scandinavia in June to get updated on the latest technology trends.

Senior managers, purchasers and consultants alike convened at the nearby Atle quarry to see demonstrations of a wide range of technological innovations and were also given the opportunity to tour Atlas Copco's production facilities. Demonstrations in the quarry showcased a full range of the latest Atlas Copo equipment including underground drill rigs, loaders, mine trucks, surface drilling rigs, mobile crushers, casing drilling and grouting equipment for micropiling, exploration equipment, handheld equipment, consumables and parts and service packages. Dynapac road paving equipment and portable air compressors were also on display.

"So many advances have been made over the last few years that we thought it was high time to present them to the world's mining and construction companies here in our own back yard," says Andreas Malmberg, President, Atlas Copco Surface Drilling Equipment. "The response was tremendous."

Intelligent products in focus

Throughout the event, the focus was on "intelligent" products which use cutting-edge technology to make rock excavation easier, faster, safer and more productive.

One of the most significant advances surrounds Atlas Copco's unique Rig Control System (RCS) which is available right across the product range. This platform enables operations to be optimized leading to higher productivity and lower total running costs.

Alberto Buffa, head of the plant and equipment unit at Italian construction contractor Impregilo was one of the participants. He told M&C: "It is the first time I have visited Atlas Copco here in Sweden and I am impressed. It was interesting to see how the company works with quality control and I was especially surprised to see the calm and pleasant atmosphere in the factories."

Naresh Prasad, General Manager, Techport, which is part of Holcim, India, said: "We are drilling in limestone quarries all over India. It is fascinating to see how far the technical development has come in just a few years and that Atlas Copco is in the forefront, not just in drilling and blasting, but also in reliability, service support and

Exploration drilling was also high on the agenda demonstated by this Atlas Copco Christensen CT20 rig, the latest and largest in the range.

Views from the professionals: Top row, Violin Filan, Hidroconstructia, Romania and Alberto Buffa, Impregilo, Italy. Bottom row Naresh Prasad, Techport (Holcim), India and Magnus Fälldin, NCC, Sweden.

training. We are not using the simulators yet but I think it is very good thing. The SmartROC D65 is very interesting as well as the big breaker."

Magnus Fälldin, one of five delegates from the Swedish construction company NCC, comments: "We have been cooperating with Atlas Copco for many years and right now we have several underground drill rigs working round the clock on expanding the Stockholm transport system. Time is money in this business which is why reliability is of the utmost importance for us. It's very interesting to see and learn about the new developments coming into the industry including the training simulators. As a member of the office staff at NCC this kind of event also helps me to understand the challenges facing the project side."

Violin Filan of Hidroconstructia of Romania is currently working with concrete rehabilitation and grouting issues in relation to hydropower construction projects. He said: "I came here to get acquainted with Atlas Copco's expertise and to see the latest solutions for grouting such as the Unigrout grouting system which is quite impressive. My view is that anything that will enable time to be reduced in hydropower construction is money saved and I have seen how the Unigrout can contribute."

Faster training with simulators

Technological advancement at Atlas Copco has not only been confined to equipment, it has also made important inroads into the field of operator training using simulators.

Atlas Copco produces simulators for underground and surface drill rigs as well as loaders and mine trucks, providing trainees with an experience that is as close as possible to the real thing.

And this method of training is a growing trend around the globe as more and more companies are obliged to keep productivity constant, at the same time as they need to train new or existing operators and get thems up to speed and into production as quickly as possible.

To achieve this goal, many mining and construction companies have saved considerable time and money recently using simulators together with Atlas Copco's Master Driller training program.

In the Atle quarry, delegates were able to try out the latest simulators for surface drill rigs such as the SmartROC crawler and Pit Viper as well as underground rigs such as the Boomer E2 C.

During the event, Maxim Guskakov of Russia was one of many visitors eager to try out the simulators, seen here in the SmartROC version (previously SmartRIG).

MINETRUCK MT 6020 takes to the skies

GHANA African Underground Mining Services has recently taken delivery of two Atlas Copco Minetruck MT6020 – airlifted directly from the factory in Sweden aboard a giant Antonov plane.

AUMS, a joint venture between Australian mining companies Barminco and Ausdrill, expects the 60-tonne trucks to bolster its haulage capacity by as much as 20 percent.

Delivery of the trucks by sea may have taken up to six months. By air, it took only 23 days from the moment the order was received to customs clearance in Ghana. Commenting on the airlift, Barminco CEO Neil Warburten pointed out that urgent requirements warrant extraordinary action.

Established in 2007, AUMS has grown rapidly in West Africa offering Australian expertise and safety standards.

Special cargo: Top left, the Minetruck MT6020 prepares to board the Antonov aircraft. Insert: inside the hold prior to take-off.

IN BRIEF

Intelligence delivered

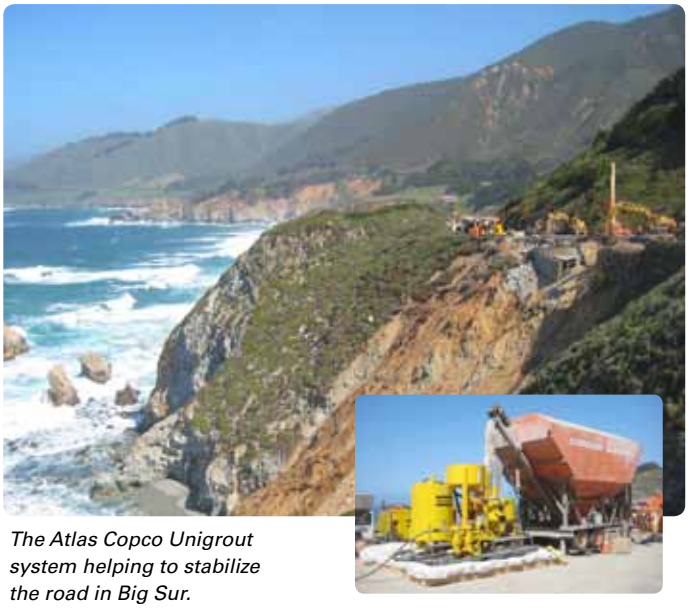
There's a sudden problem in a mine. Someone's got to deal with it fast. There's only one man smart enough to save the day – SmartROC man! That's the dramatic opening to "Intelligence Delivered", a new Atlas Copco movie now showing on the Vimeo film channel. As an action hero, the SmartROC D65 surface crawler gives viewers a glimpse of its high-tech capabilities. Other productions attracting viewers these days include "Automatic Rod Handling System for Boomer E Series", "Scooptram ST7, Next Generation Loader" and "Atlas Copco Stockholm" all on YouTube .

Great wallpapers up now!

Underground mining and construction professionals can now obtain a variety of great new wallpapers to use as background images on their mobile phones, tablets or desktop computer screens. There are five different products in the application to choose from – Boomer, Minetruck, Scooptram, Simba and Robbins – and they are all downloadable directly from the Atlas Copco Facebook page: www.facebook.com/atlascopcounderground

Good read on open pits

Blasthole Drilling in Open Pit Mining, Edition II, has now been published. It consists of 244 pages of case stories from gold, copper, iron and coal mining sites in 10 countries. As an added bonus, the book also includes product specifications, optional equipment, rock tools, compressors and boosters. Blasthole Drilling in Open Pit Mining can be ordered from your local Atlas Copco customer center (Part No.58 388 351). A pdf file (low res) can be downloaded at www.atlascopco.com/blastholedrills



PHOTOS: KEN MCCLANAHAN

The Atlas Copco Unigrout system helping to stabilize the road in Big Sur.

CALIFORNIA GROUTING

USA A collapsed section of the famous Highway 1 that runs along the picturesque coastline in Big Sur, California, gave CalTrans (California Dept. of Transportation) a difficult task. The ground had to be reinforced with 13.7 m solid bar grouted anchors but proved to be so soft and fissured that the grouting would not fill the cased drill holes.

In one hole more than 864 kg of cement was used but still the hole would not fill. CalTrans then commissioned an Atlas Copco Unigrout Flex D system to boost grouting capacity. The unit was quickly brought to the scene due to a rapid response from the Atlas Copco customer center and thanks to the plant's user-friendliness, high capacity and ability to control pressure and flow, the job was successfully completed.

Unigrout Flex D is the most modern grouting system on the market with a grout flow capacity of 120 litres per minute.

Increased demand for bits and hammers: Swedish production plant will expand with advanced technology.

Secoroc boosts production

SWEDEN Atlas Copco Secoroc is investing approximately EUR 40 million to increase capacity at the company's production plant in Fagersta. The move comes in response to increased demand for Secoroc drill bits and DTH hammers. New, advanced manufacturing equipment will be installed to boost output and reduce delivery times.

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