EXPLORATION DRILLING

By Richard Braithwaite

The multipurpose drill rig, that can both hammer and core efficiently, is now a well-established tool. UDR, for instance, has to date sold 100 of its 650 rigs. Now the technology has been taken a stage further, underground, with Colorado-based Connors Drilling Inc. having developed an underground machine that can drill RC holes (up to 11 cm in diameter) to 150 m, and then core drill onwards from H size.

The DTH hammer is well established as an explorationist's tool. However, it is limited in its capabilities by the fact that it uses air and has a poor reputation for hole straightness. Now a development from the oil industry offers a fluid hammer that is powered from the regular mud system. SDS Digger claims penetration rates 3 to 5 times faster than conventional rotary drilling and has drilled a 22 cm diameter hole to 4,300 m. Whilst the diameters, and depths, are still 'oilfield' the fluid hammer is certain to be of interest to 'Minex' drilling when it is reduced in size. SDS is now talking to Sperry-Sun about the directional drilling capabilities of the fluid hammer.

At Inco's North mine in Ontario, JKS Boyles continues to develop 'autonomation' for Inco's fleet of Diamec 262 rigs, and Boart Longyear, Atlas Copco Craelius and Hagby Asahi are all pushing new designs of wireline corebarrel. Each is claiming much the same benefits (faster descent, more positive latch/release and better fluid control). The Swedish companies are offering thin-wall versions of the regular sizes that, for instance, increase NQ core size from 48 mm to a best of 57 mm. Hagby is alone in suggesting a return to the Craelius Metric System, which allows five hole-size reductions compared with three over the popular range from H down to A (101 mm to 46 mm). This probably has its greatest application underground.

At Mount Isa Mines in Australia, Boart Longyear has mounted an LM75, 400 series feed onto a skid-steer base via a universal hydraulic positioner. The carrier includes diesel and electric power packs, the flush pump with tank and also transports the drill string. The concept was to drill a large number of short holes, very quickly.

The choice of sealed or open bearings is a question for the back end of corebarrels. Now SKF has widened the debate with its Solid Oil lubrication. Here oil is held in a polymer matrix totally surrounding bearings and races. This is claimed to provide up to four times as much oil, lower the cold start torque and increase resistance to aggressive agents – all bonuses to the driller. If you still like open bearings, SKF also produces green grease, a new biodegradable compound that is more stable than its predecessors and suitable for all bearings. Whether it is economical for the driller's other use of grease - to lubricate the rods in dry holes - remains to be seen.

Talk of over-tightened joints brings up another handy tool, the portable breakout wrench from Torquelock. This claims to be able to hold tools up to 120 mm in diameter, to produce 14,000 ft-lb torque and to run off a 12-volt battery. Other, larger, versions are available utilising the rig's hydraulic system.

Hydraulic hoses may be set to change their couplings if an invention by the Swedish company CEJN proves successful. Instead of threaded unions, they just 'plug-in'. These are not the self-sealing, QRT types that can create high-pressure losses, but open-ended couplings with snap connectors. With pressure ratings of up to 350 bars, seals and catches are built-in and disconnection is just as easy. A thousand scored knuckles and dropped spanners will welcome these!

Environmentally-friendly hydraulic oil follows, naturally. Hydrox Bio 68 is specifically designed to emulsify with up to 20% of water, essential for drill rigs and, whilst remaining biodegradable, will still not foam or oxidise.

Safety First

The Boart Longyear Semi-Automated Rod Handler won the 'People's Choice' award in the New South Wales Mineral Council's Occupational Health and Safety Awards. After 5,000 m in five months underground, "the rod handler delivered major safety benefits in a working environment that presented many difficulties". The contractor, John Nitschke, won a similar award for its rod handling system in South Australia. There is no manual handling of rods between the 150 m capacity drill box and the rig running them into the hole.

These rod handlers, and others like them, will make a major contribution not only to rig safety but to the future quality of drilling worldwide. By removing the hard manual content of the job, drillers will find more to attract them to the industry, an easier workload within it, increased time for training and a calmer atmosphere in which to solve problems and improve quality for the client.

The British Drilling Association (BDA) has been much exercised by the latest regulations from the UK Health and Safety Executive that deal with "prevention of access to, and stopping, rotating parts". This puts the onus on contractors both to guard rotating machinery and to furnish those guards with automatic cutouts. The BDA Guidance Notes incorporate risk assessment of the various types of rotary drills and are required reading for the owners of (an estimated) 2,500 rigs in the UK.

A recently reported intersection of a surface exploration hole by a blast hole being drilled by a Jumbo might have been disastrous. Two tonnes of water, with a head of 150 m, exploded onto the Jumbo. No one was injured but recommendations were made that all surface drill holes should be grouted off and their surveyed paths entered onto operating plans. That sounds like good sense and a link to the next section!

Survey and Directional Control

A supplier of borehole positional survey tools**,** Ausmine, seems to have taken a logical step in marketing its Liwinstone steerable core barrel. When your single-shot survey tool says the hole is deviating off line, this core barrel will correct it for you. A single-tube core barrel is held in bearings within a bent outer tube, which can be locked to the borehole wall. After orientating the bend, the flush pressure engages the locking mechanism, which consists of four rows of 'skates' positioned where the back-end stabiliser should be. The skates prevent rotation of the bent outer tube but allows it to follow the penetration made by the single-tube core barrel. Apart from continuous core, the advantages over bent motor systems are that it uses the regular flush pump and drill rods, and requires no reaming of the bend.

Anderson Drilling's Ball Mark system is designed to orientate core from inclined holes. This uses a ball bearing in a soft metal, circular ball race on top of the inner tube. When the core is broken off at the end of a run, the ball marks the race, on the low side of the hole. On recovery to surface, the core that is locked in the catcher box is orientated to the dip of the hole. The rest must be jig-sawed together. It is simple, cheap and effective in all but very broken rock.

Sasol Coal in South Africa claims to be the only coal mining company to have used surface directional drilling in its routine operations. Jointly with Smith Capital Equipment, the company has developed the Hotline 1045E directional drill rig. This uses the standard oilfield techniques of bent sub down hole motors and MWD surveying equipment. The hole diameter is normally 121 mm on 88.9 mm steel-alloy drill rods, and though most of the drilling is full hole, core barrels can be run when necessary. To trip

the rods, the rig uses carousel magazines loaded by crane. To define dip and strike of the dolerite intrusions, which intersect the coal seams, Sasol makes triple intersections and regularly deflects up or down to collect data on the foot- and hanging-wall of the coal.

Sasol also undertakes horizontal directional drilling underground. In order to run multi-shot surveys without pulling the drill string, the company must use non-magnetic collars above the steering tool. These are made of copper-beryllium and have not only proved ideal for the job, they actually outlast the old steel collars. It appears that, surrounded by coal at all times, a layer of beryllium carbide is formed on the collars giving a tenacious skin that resists wear and erosion.

Suppliers of modern electronic multi-shots boast about eliminating films, chemicals and eyeglasses - and that is great. What most fail to admit is that they require a field computer or a laptop to run the survey and download results. These represent a major portion of the cost of buying a multi-shot and, particularly in the case of laptops, are not practical tools to take onto a rig. Computers usually require a geologist or supervisor to run the survey that could otherwise be handled more easily, and far more cheaply, by the drill crew.

Full marks therefore to ReflexIT, which has designed its new MultiSmart system to run from a sealed, pocket-sized electronic notepad. This uses a radio link to download data both from the in-hole probe and later, in the comfort of an office, on to a desktop PC for calculation and results display. There are no cables and no plugs - well only this one!

Out and About

Drilling in the South American Andes could test any outfit. Following the paths of several international drilling contractors, UDR Equipment set up a permanent supply base for the area. The company's comments on the effects of high altitude and low temperatures on drilling operations make interesting reading.

Not only will drillers need around US$300 worth of extra clothing (which is never a one-off expenditure) but you may have to double their numbers to overcome the effects of altitude. A diesel engine will lose 12% of its power when you raise it 1,000 m but it will still be able to drive the compressor because that will have lost 24% of its output! By the time you have added sump, fuel and battery warmers to the engines, with wireline, mud and shack heaters to the rig, you are looking at a major extra power requirement. Then shorten the drilling season by 50% and double the access costs and you discover that drilling in the Andes is not for the faint hearted.

One of these contractors, Major Drilling, was involved on the Pascua Lama gold project, employing 100 people at an elevation of 5,200 m. Apart from the altitude, the company identified the following as its principal obstacles: drilling beyond 200 m in unconsolidated formations, adapting equipment to the environment, providing electrical power and hauling water. All of these problems were eventually solved, rigs reached 600 m with minimum loss, and a tunnel, driven by the client Barrick, eased most of the supply problems. Over the course of this project, Major Drilling managed to increase production and even reduce costs to the client.

Drillers, of course, are always ingenious. Diesel exhausts, cooling water and cab heaters are piped into unlikely places and this writer knows a driller who took a return hydraulic hose up one trouser leg, round his neck, down the other leg and back to the hydraulic tank. Not to be recommended but at least he couldn't leave the controls.

Unidrilling of South Africa has recently completed a six-month, 22,000 m contract at Bulyanhulu, Tanzania. The drilling involved surface and underground work, diameters

from 35 mm to 96 mm, and depths from 30 m to 1,400 m with some directional work thrown in for good measure. The use of down-hole motors with computer modeling software has enabled the company to target reef intersections with "absolute precision". Unidrilling has won the next stage of the contract on open tender. What more can you say?

The drilling industry is made up of a handful of huge international companies, hundreds of medium size and thousands of very small ones. One such minnow is Carnon Contracting, the last remaining drilling team from the Cornish tin mines. The company recently completed 4,000 m of T2 56 core drilling underground for TVX Hellas in Greece. Carnon used an unusual combination of air powered Boyles Bazookas and electro-hydraulic Craelius Diamecs, both driving Longyear consumables. Although a generation apart, these rigs were, and are still, highly effective for the job in hand.

Keep it Light

RG Crisp Drilling, a contractor from South Africa, has built a 'man-portable' rig, the Hydco MP250. Perhaps 'men portable' would be a better description as the derrick alone takes up to 12 people to lift it! The point is made, however, by the low environmental impact - a minimum of roads and only small drill pads are required. The rig is also equipped with a portable multi-purpose drill to secure it to the ground, whether it is rock or sand. This system would improve the efficiency of most of the rigs featured in this article.

Another lightweight rig, the KL 10, comes from Australian manufacturer UDR. The heaviest item again is the feed mast, at 97 kg. The rated capacity is 150 m of BQ, or 100 m of NQ.

In a remote mountainous region of southwest China, Boart Longyear has commissioned a second LF70 for Sichuan Huafeng Drilling for copper and nickel exploration. Here, due to the lack of helicopters, teams of porters and horses carry out the rig moves. There must be something almost poetic about a silent rig move; or do the porters sing?

The Corporate End

The biggest get together of 2000 must be that of Boart Longyear and Layne Christensen in their 'strategic alliance'. BL is set to manufacture non-diamond consumables, and LC to make the rigs and pumps. This move follows closely on Anglo American's announcement that it is to dispose of its shares in Boart Longyear. For BL it is business as usual.

Atlas Copco Canada, disguised under its Craelius subsidiary, has acquired Hobic Bit Corp. Whilst the Hobic name will be kept, Craelius now becomes one of the largest bit suppliers in the world, with a manufacturing base in China.

In 2000, Dando Drilling celebrated 133 years in the drilling business; can anyone beat this? Dando is known worldwide for its water-well drilling rigs and, in the UK particularly, for its geotechnical machines. Less familiar is the company's Mintec range - dual purpose rigs for both RC and diamond core drilling - one of which was recently shipped to Ghana for gold exploration. These are usually track mounted, but Dando has recently supplied two very mobile looking machines mounted on Mercedes Unimog 6 x 6 trucks.

If drillers are, by nature, a nomadic race then there is one place where they can all get together. A new website (www.drillersclub.com), sponsored by Atlas Copco, is a mine of information, technical solutions and idle banter. The serious end starts with product news and second-hand sales and it progresses downwards, as you would expect from drillers, through 'Chatpoint Charlie' to 'Driller's Challenge' .

People

Tim Bremner of Boart Longyear (and president of the Canadian Diamond Drilling

Association) says that "today, drilling rates are at record lows". The seven or eight year cycle of boom and bust has brought his company a 90% reduction in overseas work and a halving in exploration expenditure at home since 1996. But the industry is able to survive these low drilling rates, for a time at least, as a result of improved technology - "crews drill deeper, faster and more reliably than in the past". This is particularly true underground, where technology has allowed one man, and, occasionally, unattended operations. Why has this not happened for surface drilling?

Quote of the year comes from Chris Towsey who, after 25 years as an exploration and mining geologist, joined Century Drilling of Australia. "There's nothing like running a drilling company to make a geologist realise the complexity of rigs, the costs involved and the extremely narrow profit margins under which most drillers operate. It also made me realise the necessity for a safe operation. One momentary lapse of concentration was all it took for a life-changing injury to occur." Gamekeeper turned poacher?

Another Australian, David Stevens, has been awarded the Order of Australia - an honour believed to be the first of its kind in the industry. His huge experience, skill and wonderful sense of humour have been welcomed in both Americas, throughout Africa and the Middle East, and across his own continent.