Advanced raise boring

New technology provides expanded mine design options

At 6.7/6.1 m in diameter by 846 m deep, the J. S. Redpath Redbore 100 raise drill is completing what Redpath says is the "longest and largest by volume, directionally steered bored vent raise in North America; fifth largest in the world. Significant aspects of this development, at lamgold's Westwood project in northwest Quebec, Canada, not only lie in the fact that the raise was built using the highest thrust machine and largest capacity raise drill package on the planet but also that the work was completed despite extremely difficult ground conditions."

The requirement for long (610 m or more) large diameter (3.7 m or more) raises has been steadily increasing as existing mines continue to go deeper and new mines are being developed at greater depths. While long, large raises have been bored to lengths of over 1,000 m dating back to the mid 1980s, Redpath judged these undertakings to be excessively high in risk, due to the limitations in existing drill rod design, as well as machine capabilities.

With projected increase in demand, Redpath contacted Mining Technologies International (mti) to investigate thread and drill rod design. Based on these advances, Redpath undertook designing a raise drill capable of fully using mti's highest capacity drill rod to date - the mti 315, a 368 mm outer diameter drill rod with capabilities of 15,569 kN of thrust and 790,000 Nm of operating torque. The result is the Redbore 100 shown in Figure 1, with sizing shown in Figure 2.

Redpath says the Redbore 100 package "provides 75% more power than prior high capacity raise drill systems, allowing raises to be developed to greater depths and larger diameters. It has the facility to raisebore 1,000 m in depth by 8.0 m in diameter in one pass. Translating into time and cost savings by providing an effective means of excavating a vertical raise that can function as a full production shaft as well as provide large capacity ventilation required in today's large tonnage high production mines."

"The Redbore 100 raise drill is one third smaller than the closest capacity raise drill rival on the market and can be broken down into smaller components for easier transportation. The compact design and low profile construction enables underground mobility and minimises excavation."

Powered by a 447 kW variable frequency AC motor, the Redbore 100 delivers 15,569 kN thrust and 56.9 kN.m breakout torque. Computer feedback enables operators to receive and analyse more underground data than ever before, increasing their capacity to avoid difficult issues and subsequent project delays.

The resulting raise is large enough in diameter and depth that it eliminates the need for several ventilation raise bores. "In the end," says Redpath, "the Redbore 100 simply delivers a faster, more efficient and safer way to make a bigger hole in the ground, bringing mines into production faster and changing the way designers are looking at new mine development."

lamgold's Westwood project is located on the Doyon property, 2.5 km east of the Doyon gold mine in Bousquet Township, some 40 km east of Rouyn-Noranda and 80 km west of Val d'Or in northwest Quebec, Canada. This area is approximately 420 km northeast of Montreal. The project covers 1,925 ha and consists of 120 titles, one mining lease, one surface lease and three tailings leases.

Directional pilot hole

The pilot needed to be directionally drilled in order to intersect a 2.4 m by 2.4 m opening at a depth of 845 m. Drilling of the pilot was

Figure 1 Redbore 100 and specifications

<table>
<thead>
<tr>
<th>Back height</th>
<th>Metric</th>
<th>Imperial</th>
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<tbody>
<tr>
<td>extended</td>
<td>7.55 m</td>
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<tr>
<td>Machine weight</td>
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<td>Rod size</td>
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<td>Rod length</td>
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<td></td>
<td>@ 324 bar (4,700 psi)</td>
<td>15,569 kN</td>
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</table>

Figure 2 Redbore sizing
done with Micon's newest generation tool, specifically made in 444.5 mm diameter, for the Redbore 100. The larger tool, combined with clean drilling water set a new record for Micon's RVDS tool. Initial drilling reached 563.5 m before a tool change-out was required; almost double prior tool life expectancy. A total of 61 days at an average of 1.011 m per operating hour were required to successfully complete the pilot hole with 0.4% accuracy.

The 6.7 m diameter Atlas Copco 'Moose' reamer was moved into position (figure 3). This newest design of reamer is modular, allowing for ease of movement in small accesses as well as assembly in small chambers. The Moose is designed for the high stresses of large diameter raises.

While raiseboring has inherent risks, the use of larger capacity drill strings matched with designed-for-purpose-and-capacity machines, allows raises to be bored to greater depths, in difficult ground conditions. This allows mine designers to have more options in the future.

The Redbore 100's next scheduled project, near Thunder Bay Ontario, Canada will be the second largest raise ever excavated worldwide, a 7.4 m diameter by 690 m deep raise for a hoisting shaft.

Redbore 100 Benefits at-a-glance
- Low profile even if using 2.13 m shoulder to shoulder drill rod
- 8 m x 1,000 m in a single pass
- Compact construction increases underground mobility and minimises excavation
- Modular construction to easily fit into most shafts and drifts
- Significantly smaller dimensions than previous models
- Power efficient AC variable speed drive system
- 447 kW variable frequency AC motor
- 15,569 kN (3.5 Mlb) thrust
- 56.9 kN.m (770,000 ft-lb) breakout torque
- Power assisted drive head for efficient thread make-up
- Anti-spinback regeneration braking
- Automatic pinion brake system
- Increases productivity and safety
- Saves time and money

With a worldwide team of professionals who have accumulated over 47 years of knowledge and expertise, Redpath is a full service provider to the global underground mining industry.

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