



MINING & CONSTRUCTION

A Magazine from Epiroc

Vol 2, 2018

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ALWAYS ADVANCING

Especially underground

It's been a fast paced year in the Canadian mining market with the promise of an increasingly exciting future ahead of us.

The demand for Epiroc equipment, parts and services is a sure sign we are in an uptrend. And it shows we're in the midst of an ongoing evolution in mining equipment and technique. The interest in zero-emission equipment, automation and digitalization will

only continue to increase.

Whether it's new projects or the expansion of existing properties, customers are fine-tuning their operations. They are looking for ways to increase safety while cutting costs and boosting production.

That's where we excel, truly partnering with customers, taking the time to understand the constraints faced. Working side by side with our customers in



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the field is at the very heart of our business. We guide customers toward the best existing solutions – and innovate new ones. We listen. We analyze. And we work to help you overcome obstacles and achieve goals.

In this issue of Mining & Construction Canada you'll get a closeup look at one example from my product area – the automated Simba production drill. That rig is hard at work in Canada right now.

We also share stories of the new DB40 water well drill, construction success with Hutte surface drilling equipment and a rebuilt Pit Viper blasthole rig that has an incredible 63,000+ drill hours.

Enjoy the read!



TRAVIS BATTLELEY

Business Line Manager – Underground Rock Excavation

HEAD OFFICE:
1025 Tristar Drive
Mississauga, ON L5T 1W5
Tel: 289-562-0100

Also find us at:

AB	Edmonton	780-483-7214
BC	Langley	604-514-5690
BC	Prince George	250-562-8786
BC	Sparwood	250-430-1291

SK	Creighton	306-688-3090
MB	Thompson	204-778-8005
MB	Winnipeg	204-633-4888
ON	Balmertown	807-735-1104
ON	Lively	705-673-6711
ON	Marathon	807-229-9910

ON	Timmins	705-268-5595
QC	Cadillac	819-759-3601
QC	Saint Apollinaire	418-881-0101
NF	Pasadena	709-686-2480
NF	Wabush	709-288-0216
NWT	Yellowknife	867-444-9186

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www.epiroc.com

Phone: +1 (800) 465-6719

PUBLISHER Brianne Cartmill
brianne.cartmill@epiroc.com

EDITOR Scott Ellenbecker, scott@ellcom.us
Ellenbecker Communications
30124 State Highway 264
Round Lake, MN 56167 USA
507-945-0100

SUBSCRIPTIONS Subscriptions@ellcom.us

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to think safety first and always use proper ear, eye,
head and other protection as required to minimize the
risk of personal injury.

 **Epiroc**



► Red Chris Mine

Owned and operated by Red Chris Development Company Ltd. (RCDC) ► A subsidiary of Imperial Metals. It is a working partnership based on an Impact, Benefit and Co-Management Agreement between the Tahltan people and RCDC for the life of the mine.

Commissioned in 4Q 2014 ► Current mine life to 2043

30,000 tonnes per day ► Open-pit, conventional milling operation

2017 production target ► 76 to 80 million pounds copper and 33 to 37,000 ounces gold

Midlife – no crisis

Rebuilt Pit Viper keeps racking up productive drill hours after rebuild

When Red Chris Mine's Epiroc Pit Viper 351 first turned drill string to the right, Paul Martin was Prime Minister.

Melissa O'Neil won the third season of Canadian Idol. And a new video-sharing concept called "YouTube" had just made its debut on the World Wide Web. All this time, the rig has been hard at work day and night, accumulating 63,000 drill hours since 2005.

The rig has been at the copper and gold mine, owned by Imperial Metal Corporation and located 80 km south of Dease Lake in northern British Columbia, since the mine opened four years ago. Red Chris chose the used 2005 model PV-351 – now known as rig Red Chris Rig No. 901 – to be its sole high-production drilling rig.

It still wears its original beige paint. The Pit Viper's longest break was three-weeks in 2014 for a "midlife rebuild." Rebuilding a Pit Viper in the field in such short time is remarkable in itself, but in this case, not only were some of its larger components like its airend and engine replaced, it was fully upgraded from its third-party operating system to Epiroc Rig Control System 4 (RCS 4).

Tom Castle, Mine General Foreman, said, "The Pit Viper 351 is a terrific rig. It's been our primary production rig since day one, and I am very pleased with it. Faced with replacing it or getting another, I would have no hesitation at all in considering another 351 based on our experience with this one."

Dave Robinson is Epiroc Account Manager for British Columbia and Alberta. He said Red Chris ensures the rig is always running at peak performance through its service agreement, which includes full-time Epiroc Product Service Technician Luke Panagopoulos. For a time, Red Chris did its own maintenance but now entrusts it to those who know the Pit Viper best. Robinson said Panagopoulos makes himself a valued member of the Red Chris team. "Luke is always ready to jump in on whatever project they might have."



The bit assessment includes examining the bit currently in use on the rig as well as in the used bit pile. Epiroc Rotary Bit Engineer Jim Gillum (left) conducts an assessment of the bit on the rig with the help of Dave Robinson, Epiroc Account Manager for British Columbia and Alberta. Gillum also spends time in the cab with the drillers, observing how the bit is being used firsthand.

In December Robinson accompanied Epiroc Rotary Bit Engineer Jim Gillum for a bit assessment at the mine's request. The assessment is provided at no cost to any customer running Epiroc rotary bits.

Red Chris had been using Epiroc 12 ¼-inch conical, hard-nosed carbide rotary bits. This bit was giving drillers penetration rates of up to 99 meters an hour with an average of 60 meters an hour in softer rock during development. As the mine moved down into its pit's hard, competent rock for production, the rates were only about 35 meters an hour. Red Chris needed to know if this was still the most productive and economical bit for use in these new drilling conditions.

Gillum began his assessment with on-site dull-bit grading in their used bit pile and then graded the bit in use on the rig itself before he and Robinson conducted a rig calibration. Rig calibration would verify that whatever

recommendation Gillum made would be based on accurate drilling data.

An RCS-based operating platform enables a rig to drill so precisely, Robinson said, that it's a good practice to calibrate Pit Viper rigs annually. Calibration of the rig's true pull-down and air delivery, he said, can be compared to knowing how accurate a car's speedometer is. "Telling the officer that, according to your speedometer, you were weren't speeding won't get you out of a ticket. But if you know what your speedometer is telling you, you make an adjustment. You avoid the unnecessary expense of not knowing."

The calibration process did not require much downtime from Red Chris driller Russell Abrams. He had been finishing a 245-hole pattern of 12 ¼-inch blastholes and 10 ⅝-inch trim and buffer holes at the 1400 level. Red Chris controls charge depth with stemming, and this plan specified the



Red Chris driller Charles Newton demonstrates his technique during the bit assessment visit. (Right) Driller Russell Abrams in the PV-351: "Look at all the room in this cab. It's got everything I need. I think of it as my second home."

13.8-meter holes to be sub-drilled to at least 14.3 meters.

Abrams has been drilling at Red Chris in Rig 901 since it opened. When Robinson suggested that he could put him in a new rig instead of the old 2005, Abrams laughed, and he winced at the suggestion of operating the rig teleremotely from an office back in Prince George. "I'm invested in this rig," Abrams said. "I've worked alongside the technicians on it. I've helped with service and maintenance. It's a sturdy rig, and look at all this room in the cab. If they do buy a new one, someone else can operate it. I'll stay in this one. It's got everything I need. I think of it as my second home."

Abrams moved the rig off pattern and pulled the bit to prepare for the pulldown and air tests. The pulldown test consisted of bearing down three times at each of five incrementally increasing forces. These began at 20,000 lbf, stepping up to 110,000 lbf. When the rig's display indicated the target pulldown force, Robinson compared the readout with load measuring equipment's value. Ideally the two indications should match exactly. The second series of tests showed minor variance, which can be explained by such variances as a shift in the ground. The other two sets showed the rig's sensors to be a near perfect match. "These are very good results," Robinson said.

Robinson and Gillum also tested the rig's maximum downforce. They stopped when measurements had exceeded 120,000, satisfied the rig had no trouble meeting its rated capacity of 110,000 lbf.

Next they measured air capacity. Robinson

had Abrams send air at 100 percent capacity three times each through five orifices attached to the drill pipe. Compressors are generally gauged by the air they deliver at the compressor, but this test procedure measures air actually reaching the bit. Again, the rig's gauges passed the test and no adjustments were necessary.

The rig calibration had taken only a couple hours to perform and showed sensors were reading well within their tolerances. Any recommendations Gillum made for bit choice were now guaranteed to be based on accurate data.

Gillum's analysis was that Red Chris was using the correct bit. In softer rock the drillers had become accustomed to faster penetration rates. Other operations in similar formations would consider 35 meters an hour excellent. Gillum believed, however, they would get the most from the rig with just a few adjustments. Red Chris had been running bits with $\frac{7}{8}$ -inch nozzles and restricting their compressors to 65 percent air. If they changed to 1-inch nozzles, Gillum suggested, and ran at least 80 percent air to flush the holes at highest efficiency, drillers should be able to increase pulldown from 60,000 pounds to 80,000 pounds. The bits are designed to handle greater downforce, so not only would the drillers experience an increase in penetration rate but longer bit life as well.

Robinson and Gillum also offered Red Chris driller training, to help them understand how the changes affected performance. They asked if Red Chris would periodically share its bit tracking data, and Epiroc would help them assess the benefit of the adjustments.



Red Chris Maintenance General Foreman John Kasic says, "It's an incredible machine. From my technical point of view, I really appreciate a machine that runs that well."

Rig No. 901 has been so reliable that Red Chris has not needed a back-up Pit Viper in their pit. However, the mine is currently considering adding another rig to its fleet as part of Imperial's objective for expanded Red Chris production. The next rig might be a PV-271, which could be assigned to 10 $\frac{5}{8}$ -inch work trim and buffer work in the pattern. Another PV-351, however, would give the mine precautionary redundancy, should No. 901 ever go down.

After all, two prime ministers have followed Martin, and Canadian Idol has since been canceled. YouTube is still around and Rig No. 901 shows no signs of slowing down. Even with 63,000 total drilling hours – 18,000 since its RCS upgrade – it still has plenty of life left.



Pit Viper rebuild in the field

All of a Pit Viper's main components can be replaced. Using **remanufactured** components gives mines an economical way to keep their Pit Viper rigs running for years. They can even be completely overhauled again and again, each time receiving the most current upgrades if the owner chooses. Midlife rebuilds save mines great expense in not having to replace capital equipment with new machines.

Dave Robinson, Epiroc Account Manager based out of Prince George, BC, believes the term "midlife rebuild" to be a little misleading, preferring to think of it as scheduled maintenance. "To me, 'midlife' implies the rig's life is half over. But at 20,000 hours or so, our Pit Vipers are still young, just getting started."

Transporting a rig to the Pit Viper rebuild facilities in Tucson, Arizona, however, can require nine truckloads and high transportation costs. Red Chris Mine's 2005-model PV-351 was rebuilt in the field.

But this was no ordinary rebuild. Epiroc transformed the rig from its pre-Rig Control System operating platform to RCS 4, giving it the same precision automation capabilities of any Pit Viper in production today.

"Upgrading a pre-RCS rig to RCS is rare. I believe we've done it before," said Robinson, "but I can't think of another example offhand." David Linger was one of the four Epiroc Drilling Solutions technicians who made the infield upgrade to RCS 4 look easy. Other field technicians on the job were Lyle Litke, John Jacobson and Brett Steinecke.

During the week-long preparation of the RCS upgrade package at the factory, the field team replaced all wiring, boxes and conduit from the mainframe, tower and cab to receive the new control system. "Regular rebuild work" was also performed at this time, Linger said. This included replacing or repairing the engine, undercarriage, rotary head, cylinder, rod support and carousel.

In all it took just three weeks of coordinated effort through the Epiroc center in Prince George to perform the upgrade at the customer's mine site.

Now on its third property since its birth, the rig has a total 63,000 drill hours on it – 18,000 since its rebuild. "And when the time comes," Robinson said, "I'm sure we can rebuild it again." ●

In all it took just three weeks of coordinated effort through the Epiroc center in Prince George to perform the upgrade at the customer's mine site.



Built your way – Diamondback DB40

Water well drillers can't count on every job being the same as the last. Lacking the right application components for a given job used to mean buying an additional rig, or passing up an opportunity.

Epiroc has now introduced a rig that gives water well drillers the diversity they need with lower cost of ownership. The new Diamondback DB40 is a lighter-weight, cost-effective, modular rig with increased performance. The DB40 design was started after input from drillers and operators.

Robert Renaud, Business Development for Epiroc Customer Center, said, "We're happy that Epiroc has released this new rig to the industry. Our water well drillers run family businesses. It is a big deal for them to upgrade from one rig to another. Their alternatives had not changed much over the years. Now we offer them a fresh, new machine designed with the right axles and weight capacity to make it easier for them to get to their jobs, and they appreciate that."

Renaud said the new rig's options and modular concept alleviates a lot of the stress in choosing the "right" rig during an upgrade. Every Diamondback is exactly the rig its owner needs it to be – for a wide range of applications. "Being able to choose between



Interlocks on the head slide further enhance the driller's safety, ensuring the driller used the correct sequence of operations. The head can also be "locked" while drilling to prevent the head from moving if the joystick is accidentally bumped in drilling mode.

Hopper Water Wells, a family-owned well drilling company out of St. Marys, Ontario, hosted a Diamondback demonstration while the rig toured Canada. Drillers from the region saw the rig first-hand in a real setting.

single-rod loading, carousel or hands-free rod handling is going to be popular."

Driller-driven design

Cody Green, Epiroc Water Well Product Manager, said the resulting Diamondback is based on core features from legacy products drillers trust and depend on. "We have taken our time-proven designs, like electronic air regulation system (EARS) and our load-sensing hydraulics, and we have built up a modernized, modular drilling rig."

That means drillers keep what they already depend on while taking advantage of new advancements in technology and expanded application capabilities.

Not only did the Diamondback design start with driller input, but even into the final

testing phases Epiroc used involvement and field testing by experienced drillers as an effective tool to make sure the Diamondback meets the expectations of the drilling industry.

The DB40 capabilities begin with 40,000 pounds (178 kN) of pullback and 30,000 pounds (133 kN) of pulldown in a rig that's roughly 725 kg lighter than a base model TH60 rig. The two-speed rotary head has 8,000 foot-pounds (10,840 N m) of torque with variable speed from 0 to 184 rpm.

The design distinguishes the Diamondback from other rigs, allowing drilling companies to customize their rig to their application and offering packages to increase their versatility.

The rig includes features drillers felt were needed: increased feed speeds, hands-free pipe handling, an adaptable table for multiple through-hole sizes, reduced weight, improved hose management, and an increased range in jib boom design.

The tower is another valuable asset of the DB40. Green said, "The DB40 tower design is similar to our T2W tower design but with custom formed channels that allows the DB40 strength to increase to 40,000 lbs of pullback. The tubular tower is ideal for adding a casing hammer and, with the new tower design, the DB40 is lighter weight than a TH60 and opens up the work area around the drill string for an abundant amount of space for drilling operations."





Base rig

All orders start with a Diamondback “base rig.” The customer then chooses configurations to their specifications.

Green said, “It allows for customization of the rig during the build process and after. The bolt-on carousel can be removed or swapped out to different sizes. Options like the automatic rod loader can be added for hands-free pipe handling. The table bushing can be removed to allow for multiple through-hole sizes in the table. The Diamondback even has three rotary head packages to select from to target standard water well jobs, or a water well/reverse

circulation combination, or water well/reverse circulation/coring for a complete multi-purpose rig. This allows our customers to be more flexible and perform in more applications. The DB40 will also have a better resale value since it can go into multiple markets.”

The Diamondback is a PTO rig with a 600 hp (447 kW) X15 Cummins engine or a deck engine configuration in either Tier 3 or Tier 4 Final. It comes with any of three towers: standard 34-foot tower (10.4 m), 38-foot (11.6 m) tower or multipurpose 38-foot tower. There are three packages to choose from for airends.

The on-board airend options for the DB40 utilize an Atlas Copco compressor with 550 cfm/200 psi or 1,070 cfm/350 psi. Drillers running only mud or using their own off-board compressors can opt for the “no-air” package. Eliminating the air package not only reduces the weight by removing the airend but a lighter, smaller horsepower engine can also be selected to increase fuel economy even further.

The resulting Diamondback has been put to the test but by actual drillers in the field during an 11,500-mile demonstration tour across the U.S. and Canada. The DB40 is now successfully working in the field. ●

Diamondback: Combining revolutionary design & proven technology



Improved head travel

Feed speed – Quick tripping 200 feet per minute

Position to either side – Slides over driller's console while handling casing, or slides to the helper's side to handle pipe from the carousel.

Specialty application kits

Reverse Circulation kit – Above-the-head RC assembly in a compact, field-serviceable package complete with blowdown valve. Ceramic-lined cyclone assembly with a hydraulic knife valve for sample isolation.

Flooded Reverse Circulation kit – Below-the-head flooded reverse kit for drilling large diameter holes with out the need for expensive off-board mud pumps.

Coring kit – Kit includes tooling for handling coring pipe. Can be used in conjunction with coring head and high speed coring winch for retrieving core samples.

Mud Pump kit – Choose between piping packages that included on-board hydraulic pumps with quick connect ports to plug in your off-board mud pump or choose a full on-board package that includes hydraulic pump and on-board mud pump.

Driller-preferred pipe handling tools

Carousel hands-free breakout wrench – Located on top of the carousel, breaks pipe loose from the rotary head.

Sliding fork wrench – Holds drill string in place at the drill table by engaging drill string flats. Available in hydraulic or pneumatic cylinder.

Petol hydraulic breakout wrench – Uses hydraulic powered wrench to torque up or break joints at the table.

Hydraulic rod spinner – Quickly threads pipe on or off improving tripping times.

Easy-to-swap out pipe handling options

Auto rod handler – Single or Multi-Axis rod handler that delivers pipe hands free from pipe rack to the rotary head.

Indexing carousel – Use the head to load and unload a 9-rod (3.5" rods) or 7-rod (4.5" rods) carousel with side loading capabilities.

Single rod loader – Delivers single pipe to the rotary head and comes with hydraulic clamp for breaking joints.

Main winch with jib boom – Use the main winch's 18,000 lb capacity to load and unload pipe from the rod box or use the extended range of motion with the jib boom to easily reach pipe stacked off-board.



Innovative table design

3 bushing sizes – 13", 17", 24"

Adaptable on the spot – 17" and 24" come with bolt-on centralizer bushing and outer bushing adapter.

Greater access

- Back half of table retracts hydraulically for access below the table.

- Hinged front half unpins to swing away complete access to tooling below the deck.



Improved grating design and ample working space

Teleremote shifts Éléonore into higher production



Patrick Chabot
Éléonore Underground
Mine Manager

“The drillers have been engaged since the beginning. They like it very much, particularly as it is in keeping with the mine's focus on safety.”

Patrick Chabot is Underground Mine Manager at Éléonore, one of Vancouver-based gold miner Goldcorp's newest mines. Chabot credited a long-standing relationship with Atlas Copco Canada (now Epiroc) for helping Éléonore innovate its traditional mining methods to become a safer and more productive operation.

“In some places, our ore body is straight. In others it's like a snake. It's important to have equipment that can adapt to the situation,” explained Chabot. “After a rigorous selection process we chose the Simba drill rig for its flexibility and mobility, and its tele-remote capabilities and automated drilling features. We used to have an in-the-hole rig, which was a very precise machine; but it was not as mobile nor as fast, and it was not capable of tele-remote. With the new Simba drill, we've now gained so much in production, averaging between 5 and 10 percent more drill footage.”

With three Simba rigs now in operation at Éléonore, much of the drilling is still done with an operator in the cab, and operators relocate the rigs from pattern

to pattern throughout the mine. Tele-remote control of automated drilling cycles, however, enables Éléonore to continue drilling through shift changes and during the hour-long evacuation procedures after each blast, controlling the rigs from the surface.

About 30 minutes prior to the end of the day shift, the underground operator sets the rig up for tele-remote operation after establishing communication with the night shift driller on the surface. The night shift driller takes control of the rig as the underground operator leaves it. The underground operator comes to the surface to assume tele-remote control while the nightshift driller drives underground to the rig. The shift change is completed without any drilling downtime.

Twelve operators are trained on the Simba rigs, four for each rig. “The drillers have been engaged since the beginning,” said Chabot. “They like it very much, particularly as it is in keeping with the mine's focus on safety.”

From January to September 2017, of the total 120,926 meters drilled by the three rigs, 11,157 meters – or roughly 9 percent – were drilled using tele-remote. “We gained additional productivity without compromising safety,” continued Chabot. “If anything, we increased safety overall. In addition to tele-remote operations, the drills provide the operators with an enclosed, low noise, dust-free environment in the cab.”

Watch the video **Take the 'old' out of gold – modern mining by Goldcorp** featuring Éléonore's former mine manager to learn more: <https://youtu.be/cyXlvq2X92o>

Overview & Operational Highlights

Located in James Bay, Goldcorp's Éléonore Mine is one of Canada's newest gold mines, achieve commercial production in 2015. With a large, under-explored land package based on the Roberto deposit, the focus at Éléonore is on increasing underground mining rates, mill throughput and improved dilution by the adjustment of stope design.

Location	Eeyou Istchee/James Bay, Northern Quebec
Ownership	100%
Type of Mine	Underground
Processing Method	Conventional circuit, cyanide certified
Milling/Processing Capacity	7000 tonnes per day
Power Demand	35 megawatts

Number of Employees & Contractors	1200
Gold Production (guidance for 2018)	360,000 ounces
AISC (guidance for 2018)	\$900 per ounce
Gold Reserves (proven and probable)	3.80 million ounces
Gold Resources (measured and indicated)	1.34 million ounces
Gold Resources (inferred)	1.99 million ounces

Simba M6 C Teleremote

The **Simba M6 C** is a high-production long hole drilling rig for medium to large drift mining. Drill precisely parallel holes 51 to 102 mm in diameter upward or downward in patterns with up to 3-meter spacing.

Automation includes Drill Plan Handling and Full Drill Data Handling based on Epiroc's proprietary Rig Control System (RCS) with parameter pre-set capability to match a variety of drilling conditions.

Teleremotely control automated drilling cycles from a distant controller station through the mine's own wireless infrastructure or a dedicated network set up by Epiroc.

Mechanized RHS 27 rod handling system for drilling holes up to 51 meters.

Emission-free battery drive or low emission diesel engine options.

Tilt, rotation and pendulum arm contribute to accurate, smooth and proportional movements while positioning the drill.

18-40kW series Rock Drill options on a hydraulic, two-stage feed cylinder.

Front- and rear-mounted stingers ensure a stable base for drilling.

Mine-adapted carrier with articulated steering and four wheel drive.

The little Hütte that could



The HBR 202 E drill rig requires a 440-480 V, 60 Hz, 3-phase power source provided by either a site's own power supply or a stand-alone generator. For this job MSE paired it with a portable generator as well as a portable air compressor for down-the-hole drilling operations.

Tight spaces and angle drilling made possible with Hütte HBR 202 E

Rehabilitating a 1940s coffer dam near Chute-des-Passes, a village 160 kilometers north of Chicoutimi, Québec, will bring it up to modern seismic engineering standards as well as renovate the massive concrete structure. Grouting, shoring, caisson work and rock support for upgrades to the dam's diverter doors and railing system were contracted to geotechnical specialist MSE Drilling & Grouting Inc.

The dam was built on the Peribonka

River by Alcan, an aluminium mining and manufacturing company acquired by Rio Tinto in 2007. Dam operations were automated in 1974.

MSE professional engineer Jason Grenier, Project Manager on the dam project, said MSE knew going in that the most difficult part of the job would be installing 50 multi-strand rock anchors to secure the concrete structure under tension to the bedrock 20 to 60 meters below.

Grenier said had it not been for the unique capabilities of MSE's Hütte HBR 202 E drill rig, "We wouldn't have taken it on.

We would have passed." To his knowledge there is no other drill that could have been used for this job.

Access was a challenge. The structure's spillway gates and rail system left only a 6-foot-wide recessed pathway at the top, which ended abruptly at a concrete bulkhead on one end. "We had to use a crane to lower the drill rig down to it then crawl the drill to the far side at the wall. And then there's the angle of some of these rock anchors. We bid this job knowing we had a drill that could do it."

The Hütte's unique kinematics set it apart.

Unlike other drills that can only drill face forward, the Hütte's mast and feed can be positioned to its sides. It will drill beside itself with the same functionality and range of motion as facing forward. Grenier said due to the confined space and some of the angles of these holes, this project could not have been completed without this capability.

While difficulty of access was taken into account prior to taking the job, an additional complication caught MSE by surprise. "We were drilling to determine the depth of the bedrock, using the Hütte for 5 ½-inch pilot holes in 10 locations. But 25 meters into the first hole, we hit steel plate," Grenier said. "After that, we continued to run into things at random."

MSE discovered a secret of construction in remote wilderness areas 80 years ago: "It's such a remote location. The original builders used whatever they had lying around for fill. It made more sense than hauling in fill for the mix and hauling out things they had lying around."

MSE found not only the occasional rebar and steel but other scrap metal and even wooden timbers here and there in unpredictable locations. Nevertheless, they had holes to drill and pressed on.

The HBR 202 E drill rig requires a 440-

480 V, 60 Hz, 3-phase power source. MSE uses one of its own portable generators or, when available, runs its power cord to an electrical service. For this job they used the tow-behind compressor.

Configured for drilling with down-the-hole tools, MSE pairs the Hütte 202 E with one of its portable Atlas Copco XATS 1000 compressors providing air at up to 1,000 cfm at 350 psi.

The MSE crew lowered the Hütte onto the walkway with a tow-behind generator and compressor. They began each hole by first drilling 5 ½-inch pilot holes to depth. They followed these with a 10-inch hole opener.

"Due to the metal we would hit, drilling the holes was really hard on bits. The metal in the concrete sometimes jammed bits or shanked the bit head right off," Grenier said. Broken carbides would usually flush out with the cuttings, but sometimes they would have to stop drilling to fish the bit head out with a magnet.

Stopping to fish out pieces from a 50 or 60 meter hole was a tedious process for a drill string with joints every 1.5 meters. Each joint must be broken as the string tripped out. Then the crew fished for broken metal jammed at the bottom of the hole before making up the joints again to resume drilling.

Grenier said holes took on average two bits and two to three days to drill. Some took more bits and much longer time. "But the Hütte is really a nice machine. We had no problem with the drill the entire time we were there."

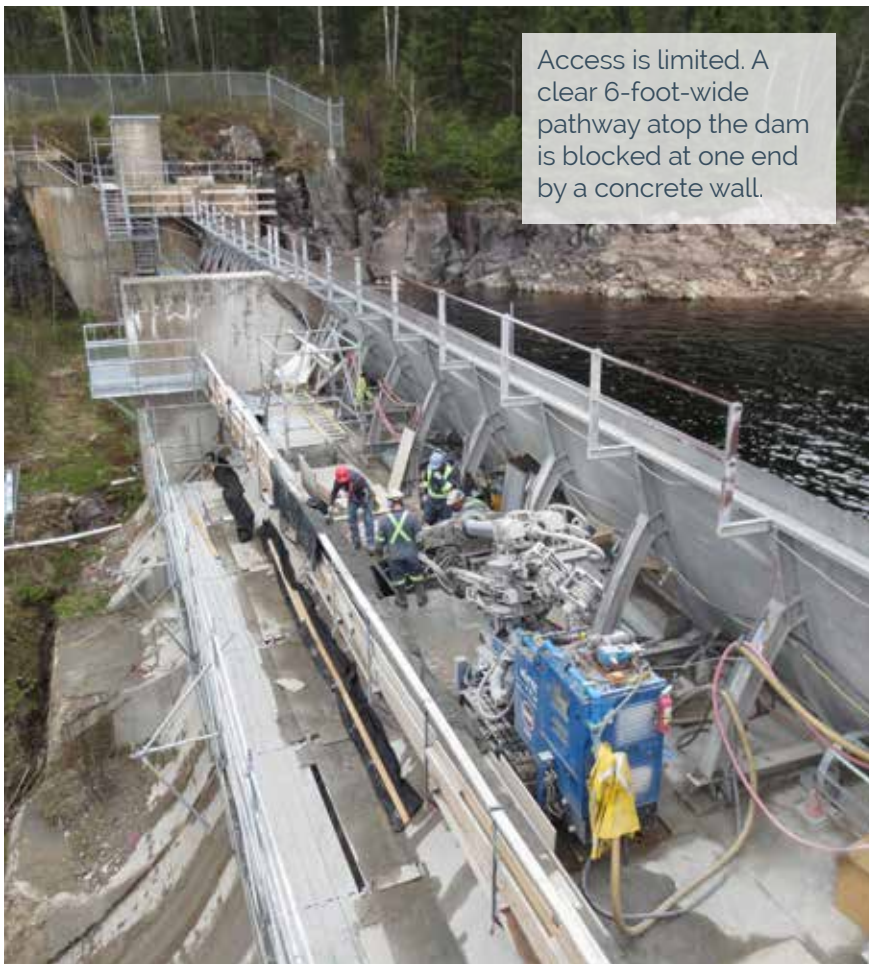
MSE was on site eight months, including time between initial exploration and the drilling of the multi-strand anchor bores.

MSE drilled, tensioned and grouted 50 anchors to complete the job. Length of anchors varied with bedrock depth, ranging from 20 meters to 68 meters. Three sizes of multi-strand anchors were used: 22-strand, 25-strand and 30-strand.

"Hüttes are nice machines," Grenier said. "We use the 202 for tie-backs, micropiling, for just about anything."

The HBR 202 E and 202 D (a diesel model) are rated for installing up to 12 ¾-inch casing. They can be configured with rotary head, top hammer setup, use with down-the-hole tools, dual rotary heads and dual rotary-percussion heads.

While the HBR 202 E represents the most compact drill in the Hütte product line, MSE also owns the largest Hütte, the 30,000-pound HBR 610, which MSE helped Hütte field test on jobs from prototype to final design. ■




Access is limited. A clear 6-foot-wide pathway atop the dam is blocked at one end by a concrete wall.



The HBR 202 had to be placed on site by crane.

 **MINING &
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