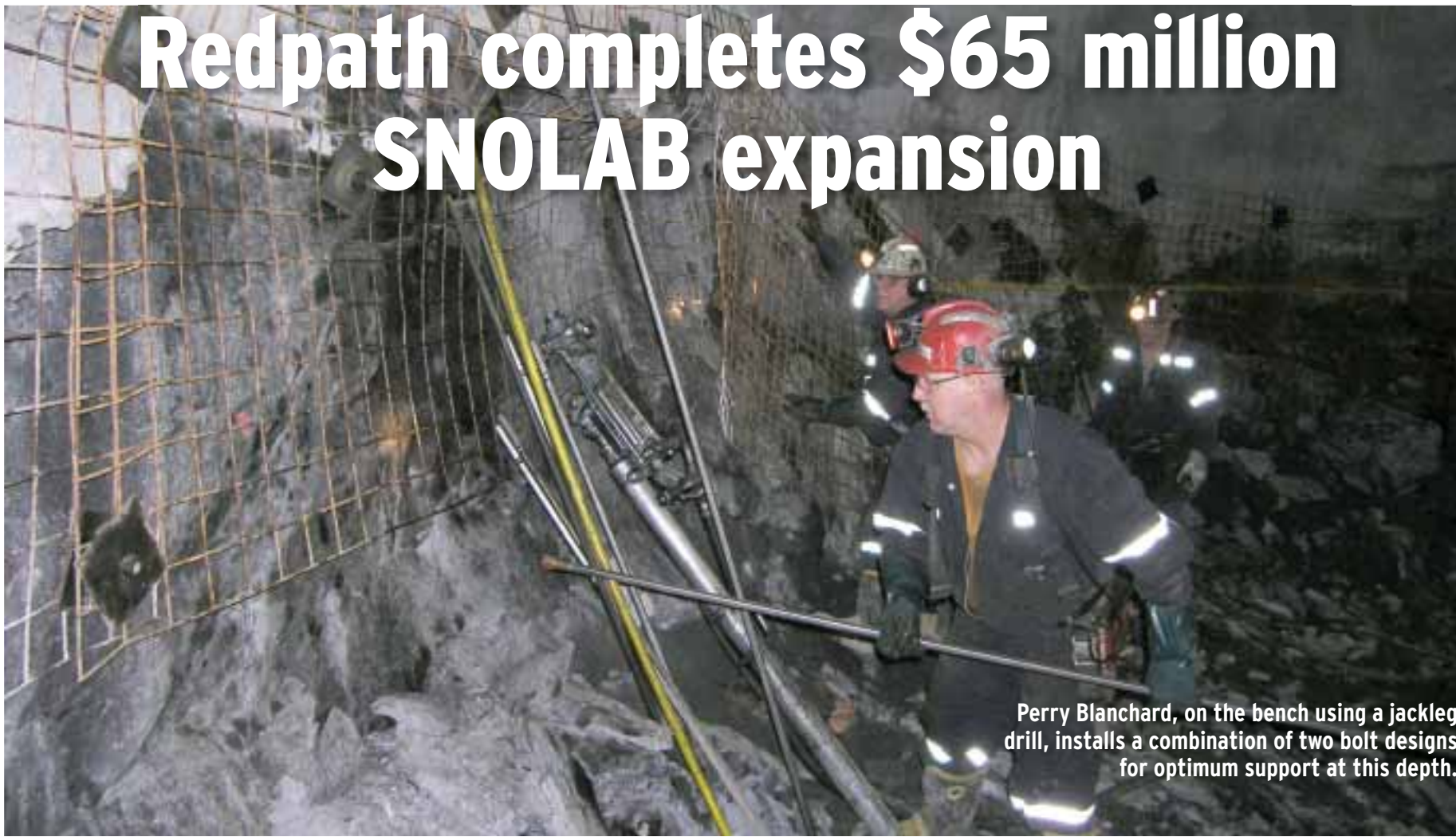
Redpath completes $65 million SNOLAB expansion



Perry Blanchard, on the bench using a jackleg drill, installs a combination of two bolt designs for optimum support at this depth.

■ Four-and-a-half years of meticulous work brings one-of-a kind underground development job to completion

BY ADELLE LARMOUR

Careful attention to detail and scheduling was the mandate the J.S. Redpath Group followed during its four-and-a-half year expansion of the Sudbury Neutrino Observatory (SNOLAB).

Located 6,800-feet underground at Vale Inco Ltd.'s Creighton Mine in Sudbury, the world-renowned research facility performs experiments in particle astrophysics. During SNOLAB's principle experiment (to detect the number of neutrinos emanating from the sun), further questions arose about the nature of neutrinos and the composition of the universe, resulting in a proposal to create an expanded international facility where several experiments could occur simultaneously.

"The success of that experiment was in large part why we were able to expand the laboratory to go on to these other experiments," said SNOLAB's associate director of operations Dr. Fraser Duncan.

Consequently, the Canada Foundation for Innovation (CFI) and the Province of Ontario provided funding for a $65 million, two-phase expansion of the underground facility to conduct experiments that will explore the properties of neutrinos, expand understanding of the energy production mechanisms in the sun and search for cosmic dark matter in the universe.

The new laboratory will host a number of experiments.

"The idea is that we'll have a continuity of experiments over time," Duncan said, adding that the process is dynamic as new experiments develop and ideas transpire.

Expansion program

Project management was overseen by Hatch Energy (formerly Hatch Acres), and Comstock Canada Ltd. is now outfitting the underground space.

The work consisted of lateral development, chamber excavation, raiseboring, construction and shotcreting. It was performed under the direction of Redpath's Rick Buckmiller, and in co-operation with Vale Inco.

It took 250,000 man hours to carefully excavate waste rock next to Creighton's mining operations and the original SNO laboratory, which remains a large cavern 72 feet (22 metres) in diameter and 96 feet (29 m) high with access tunnels for experiments and infrastructure.

"From a mining perspective, it's a bit different from the typical hard core miners that like to drill and blast," said Redpath's project engineer Dave Jackson. "It is

meticulous."

The mine development consisted of two cavern-type experiment halls, accessible from upper and lower levels, as well as 2,600 feet (792 m) of drift development. A total of 93,000 cubic yards of broken rock was excavated to build phase one's main hall, measuring 50 feet (15 m) by 65 feet (19.8 m) by 65 feet high, phase two's cryopit, measuring 50 feet (15 m) in diameter by 65 feet (19.8 m) high, and the drifts (for future offices and laboratories), which varied in size from 13 feet (4 m) wide by 13 feet high to 25 feet (7.6 m) wide by 25 feet in height. A larger grid-like section, called the BLAD (Back Ladder Access Drift), measured 20 feet (6 m) wide by 180 feet (54.8 m) long. It contains three short tunnels connected to two longer tunnels on either side, divided by three large pillars.

Completed in June, the project presented some unique challenges because of its proximity to the original laboratory and because of the design requirements.

"Detail and accuracy were huge," said Jackson. "We surveyed every cable and followed the pattern to a tee."

Contouring the rock within the larger experiment halls to attain maximum stability became paramount. The phase one hall roof (back) is dome-shaped with flat ends, like a barn, supported by barrelled walls, enhancing the structural support within the space.

Both halls were completed by silling out the top and drilled vertically with a long-hole machine. The drifts were excavated using a two-boom electric hydraulic drill jumbo.

"Rock is quite plastic," Jackson explained. "When you excavate a big hole at 7,000 ft (2 km), the rock wants to fill it, potentially inducing rock bursts."

The rock mechanics ultimately determined the support for the space being excavated. In the large openings, 24-foot (7 m) cables were installed in the walls and 33-foot (10 m) cables in the roof at five by five spacing. Resin rebar and cone bolts were installed throughout the mine workings using six-foot (2 m) lengths in the walls and eight-foot (2.4 m) lengths in the shoulder and roof.

Phase one's main hall is rectangular in shape with barrelled walls and roof for structural support.

Blasting

Blasting the waste rock became another unique aspect in this undertaking. During phase one, Redpath approached its blasting cautiously, using state-of-the-art technology to monitor blast vibrations. The closer they were to the original facility, the more they had to reduce the amount of explosives per blast.

"Normally, a drill face of 60 holes is timed in sequence so they break into a free space, but the closer we got to the original SNO facility, the more we reduced the number of holes per blast to minimize shock waves into the laboratory."

Jackson said in some areas they would ignite two blasts, clear rock, ignite two more blasts and clear some more rock.

Computerized blasting devices called Icon Blast Initiators were used for the halls. A programmable computer chip in each cap allowed the blasts to be pre-programmed for greater control in the blasting process.

Phase two consisted of tunnelling and the construction of the cryopit. This semi-circular domed roof and 50-foot (15 m) diameter cylindrical space required two access tunnels, one at the top and one at the bottom. A raise provided a space into which they could blast. Once the raise was blasted, vertical drilling was performed to complete the balance of the excavation.

Jackson said the excavation was done in a shrinkage manner, which required removing the broken rock out from under the area where they worked. As they proceeded downward, they continually screened, cablebolted and shotcreted the upper walls for added strength and support. Each cable bolt assembly consisted of two 30-ton (27 tonnes) deformed cables, providing ultimate tensile strength of 60 tons (54 tonnes).

Phase 2 tunnelling was completed with hand-held jackleg drills and stopers.

Trackless LHDs (load-haul-dump machines) mucked out the waste rock, which was then crushed underground and transferred to Inco operations below surface roadways as grade material. The excavated rock was also used as backfill for stopes. This saved money, time and avoided interfering with Inco's production schedule.

Shotcrete

Redpath applied 5,720 tons (5,200 tonnes) of accelerated shotcrete to the walls, three-inches thick. A one-inch finish shotcrete application totalling 1,340 tons (1,215 tonnes) was completed by Béton Projeté MAH Inc., shotcrete trowelling specialists from Quebec who recently put their signature on the bobsled run in Vancouver, British Columbia for the upcoming Winter Olympics. Because the research to be conducted necessitates a clean, dust-free, environment, a smooth glass-like surface was requested for easy cleaning and particulate reduction.

Redpath continues to do mine development work at Vale Inco's Creighton Mine and several other Inco properties around Sudbury. ■

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