

## Innovative thinkers

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### Chilean miner rescue: The drilling team that defied all odds

As 33 men waited 2,070 ft below the earth in a collapsed mine near Copiapo, Chile, 17 days would pass before the world even knew they were alive. August 5, 2010, marked the beginning of an event that would capture the world's attention and bring together an international drilling team who refused to take no for an answer.

Greg Hall, co-owner and CEO of Drillers Supply SA, immediately understood the severity of the events that were unfolding at the San José copper and gold mine. Having supplied drilling equipment in Chile for over 20 years, Hall knew the extraordinary challenges that the rescue operation would face.



The drilling team at the San Jose mine rescue site. From left to right, Greg Hall, Drillers Supply; Mijali Proestakis, Drillers Supply; Brandon Fisher, Center Rock; Igor Proestakis, Drillers Supply; and Richard Soppe, Center Rock.

As local companies began to mobilize their rigs, which were capable of drilling to about 1,400 ft, geologists began to suspect that the miners were trapped much farther down. In the days following the cave-in, Drillers Supply teamed up with local officials and drilling contractors to employ nine rigs, including four Schramm T685WS reverse-circulation exploration rigs, to drill a series of pilot holes to search for the miners.

“By day seven or eight, we thought we were drilling a recovery operation. We were looking for bodies,” said Hall. Then, on Aug. 22, the team got some very unexpected news. “We heard banging on the drill pipe and realized that someone was alive down there,” said Hall.

One of the Schramm rigs had successfully reached the trapped miners with a 5½-in. borehole. “The miners saw [the drill pipe] and, with red paint, they wrote a message on the end of the [drillstring],” said Jeff Roten, Schramm’s service technician who stayed onsite throughout the entire operation. The message stated, simply: “All 33 of us are well inside the shelter.” Miraculously, the miners had survived 17 days with minimal supplies. In just two more days, they would have run out of food.



Jeff Hart, of Layne Christensen, one of the operators of the Schramm T130XD. Photo courtesy of Schramm Inc.

The news personally touched Brandon Fisher, CEO of Center Rock drilling company. Fisher, who grew up in the mining communities of southwestern Pennsylvania, initially founded Center Rock in 1998. He grew the company into a drilling product manufacturer and, in 2002, he developed a low-profile (LP) drilling series using the large-diameter drills—up to 10 ft—initially developed for bridge construction. The drills’ percussion technology proved to be especially effective in drilling through extremely hard material, such as volcanic rock infused with hard minerals.

Upon hearing that the Chilean miners may not be reached until Christmas—five months after the initial mine collapse—Fisher knew he had to get involved. “It was very close to our hearts,” he said. Fisher was no stranger to mine rescue operations. In 2002, he had helped save nine miners who were trapped 270 ft underground after the Quecreek mine in southwestern Pennsylvania collapsed. As water filled the mine shaft, the rescuers drilled a ventilation hole and a second escape hole, freeing the nine miners after 72 hours.

Before the San José mine collapse, there had never been a successful rescue operation at depths of 2,000 ft. The andesite rock under which the miners were trapped was highly abrasive, with a tensile strength of about 39,000 psi. The team also had incomplete mine maps and knew that there were dozens of dangerous mine passages that, if affected by the vibration from the drill, could cause the mine to further cave in.



Workers of the T130XD celebrating after completing the escape hole to free the 33 miners. Photo courtesy of Schramm Inc.

Based on the pilot holes initially drilled, Chilean officials sought three projects teams, dubbed Plans A, B and C. Igor Proestakis, sales manager for Drillers Supply in Chile, presented the team's proposal to the government committee. "When we told them we could finish in six weeks, about 80% of the committee laughed at us," Hall said. "Nobody thought Plan B had a chance, as it was just so different."

The government approved the proposal for Plan B, and on Sept. 4, Fisher, along with several colleagues, met up with the Drillers Supply team waiting onsite. Drilling operations began the next day with Schramm's T130XD rig, operated by Chilean exploration company Geotec Boyles Bros., and Center Rock's LP drill to ream out the existing 5½-in. pilot hole to 12 in.

To assist with the drilling operation, Geotec contracted several drilling engineers, including Jeff Hart and Matt Staffel of Kansas City-based Layne Christensen. The two arrived at the mine site from Afghanistan, where they had been drilling water wells to help US military forces. Hart became the drilling chief of the operation.



The Schramm T130XD rig arriving to the San Jose mine site. Photo courtesy of Schramm Inc.

While the initial phase of the drilling operation focused on expanding the wellbore to 12 in., the team laid out plans to continue to expand the hole out to 18 in., then 26 in. to accommodate the rescue capsule system that would bring the miners to the surface. “We were confident that the T130XD was the right rig for the job. The right people and tooling were in place, and we were certain the drilling would be completed well ahead of the original estimates,” said Greg Hillier, product manager for Schramm.

The initial pilot hole, drilled at an 80° angle with a series of sharp turns (up to 4° per 10 m), could not accommodate the percussion hammers that Fisher typically used to drill his large-bore vertical wells. The team re-designed the chuck-bearing system, and within two days of sending the construction plans to the US, the equipment was headed down to Chile. Through its humanitarian supply chain organization, delivery service UPS shipped the first equipment from the US to Chile at no charge, and Chilean military officials delivered the materials personally to the site. A majority of the shipments were moved in under 48 hours.

With each day came a new challenge. When the drill bit reached 880 ft, within feet of an existing mine opening, the pilot hole bit broke off, launching a four-day fishing job. Proestakis, who had been onsite since the pilot holes were drilled, designed the fishing tool, which included a mounted camera that helped the team search for the bit. “Every 400 ft or so, only four of the five hammer faces would be touching the rock and they would break off,” said Hall. “The miners would call up to ask why we had dropped a hammer down the hole.”

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Center Rock's 26-in. LP drill Tool rigging up to go back in the hole. Photo courtesy of Center Rock.

Supplies were sent to the miners via three pilot hole shafts. One shaft supplied air and water, one supplied food, and the third was used to supply general materials, including medical supplies. Officials at the US National Aeronautics and Space Administration worked with nutritional experts to provide specialized foods and liquids to the miners, as well as clothing that could regulate their blood pressure as they ascended to the surface.

The miners, who exchanged communications with the drillers via a capsule sent through the third pilot hole, also aided in the drilling operation. “[We] would stop drilling at times to let the miners haul away the cuttings,” said Dick Schramm, chairman of Schramm.

Complications with the neck of the drills and the unknown maze of production tunnels that crisscrossed the shelter caused further delays. “It was one of the most stressful situations you can be in,” Fisher said. “Every drilling setback was affecting human life. It [upped] the level of urgency and the pressure to get to the bottom of the hole.”

After a 33-day drilling operation, the team feathered the roof holes and broke through to the miners. On Oct. 12, more than one billion people watched as the first miner, Florencio Ávalos, emerged from the rescue capsule after being trapped for 69 days. Chilean President Sebastián Piñera greeted him with the words: “Welcome to life.” Within 24 hours, all 33 men were reunited with their loved ones and hundreds of supporters who gathered to welcome the miners at the rescue site, named Campamento Esperanza, or Camp Hope. “It was a very emotional moment,” Fisher said.

Since the historic rescue in Chile, Fisher and Hall have launched efforts with US state and federal agencies to reinstate the country’s rapid-response drilling program, which was disbanded in 1975. Fisher is also working with officials abroad to develop emergency response drilling procedures.

“We had the best people, the best equipment. We were determined not to fail,” Hall said. “The miners had faith and never gave up hope. That gave us the impetus to go one more night without sleep ... It’s a crucial difference when you’re drilling for people, not for profit.” **WO**

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