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The 2010 Chilean Mining Rescue (B)

As news of the miners' survival spread, media interest intensified. Journalists and writers around the world boarded flights to Chile. André Sougarret and Rene Aguilar vigilantly protected the technical team from media glare, while the team worked to drill two additional probe holes to complete the set of three holes needed to provide the miners with food, air, and communication.[1] As millions of viewers around the world celebrated the miners' survival, a survey of their health revealed them to be physically fragile. Mario Sepúlveda had lost a tooth in one of his escape attempts, Víctor Segovia was having severe earaches, Mario Gómez was having difficulty breathing, José Ojeda was diabetic, and all needed vaccinations for pneumonia and diphtheria.[2]

Above Ground: Days 18–28

In the early days of the crisis, President Sebastian Piñera had asked aides to contact experts in supporting people in extreme confinement. In response, specialists from the U.S. National Aeronautics and Space Administration (NASA) and from the Chilean Navy's submarine fleet arrived at San José shortly after contact had been made with the 33 miners. Applauding the efforts underway, NASA experts warned Chile's team of health professionals of potentially difficult reactions during and after extreme confinement, including rebellion against established leadership, swings between euphoria and stress, and fatigue from the monotony of daily routine. They recommended better lighting to simulate day and night for the miners, maintaining a strict organizational hierarchy below ground, and supplementing miners' daily chores with reading and watching movies.[3]

In search of a precedent to guide the rescue approach at San José, the off-site consulting team studied past mining accidents. Notably, in 2002, an accident at the Quecreek mine in Pennsylvania, had left nine miners trapped at a depth of about 75 meters. Although trapped at a much shallower point than the 33 Chilean miners, the rescue of the nine miners—using escape capsules sent down through drilled holes—had been considered a remarkable feat at the time. Now it was a suitable example for study. Using the shoulder width of the largest of the trapped miners as a baseline for measurement, the design of an escape capsule for San José was commissioned. The Chilean Navy, in collaboration with NASA and people who had worked on the Quecreek rescue, began building these capsules. Meanwhile, the work of the off-site consulting team during the search period meant that at least one of the rescue options evaluated by them was ready for execution.[4]

Professor Amy C. Edmondson, doctoral student Faaiza Rashid, and Professor Herman "Dutch" Leonard prepared this case. HBS cases are developed solely as the basis for class discussion. Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective management.

Plan A

The first of the selected plans, called Plan A, would utilize the Australian-built Strata 950 drill rig, normally used to drill circular shafts connecting two levels in a mine. With a total weight of 40 tons, the Strata 950 had to be shipped in parts to San José from a Codelco-owned mine. The rig would first drill a 46-centimeter diameter hole to a depth of about 700 meters; the hole would later be widened to fit the rescue capsule. The cost of Plan A was estimated at US$3,000–$5,000 per meter of drilling.[5]

As the rescue team awaited the Strata 950's arrival, a drill platform was constructed to support the massive rig. Because the Strata 950 could only drill vertically, the platform would have to be situated directly above the refuge. None of the existing probe holes could be used because they were not perfectly vertical. Given the rig's colossal power, the plan seemed a viable, albeit slow, option, requiring an estimated three months to reach the miners. Maintaining the well-being of the miners for 90 days in their stressful circumstances was a major risk of Plan A.[6]

Plan B

> On August 24, as the Strata 950 parts were being delivered, Igor Proestakis, a 24-year-old field engineer from Driller Supply SA—a Chilean subsidiary of Driller Supply International—returned to San José. Soon after the mine collapse, Proestakis had visited the accident site to provide technical advice to drill operators using his company's equipment there. He was now at San José again, representing his company, when he ran into Walter Véliz and Felipe Matthews, both old friends of his family. Proestakis, Matthews, and Véliz began sharing their ideas on rescuing the miners and conceived what would eventually become Plan B.[7]

Proestakis thought the fastest rescue option should use "cluster hammer technology" manufactured by Centerrock, Inc., a U.S.-based company that manufactured drilling equipment, whose products Driller Supply had previously distributed in Chile. Proestakis believed that this technology could widen one of the existing probe holes, allowing the miners to be rescued within 45 days at about one-quarter of the cost of Plan A. He explained:

> I told them, if you have hard ground go with hammers because they work well on hard ground. You can go with a single hammer with a single piston, which will try to deliver all its force to the rock, but if it fails, that force will hit back and break the piston. Another option is to use multiple hammers, each with one piston, so if one piston fails you can still keep drilling.

Proestakis had rough estimates for cost, sizes, and technical details in his mind, which he shared with Matthews and Véliz. They, in turn, asked Proestakis to spend the next two hours preparing a presentation for Sougarret. Proestakis recalled, "My inner reaction was 'You want me to do *what*?' I mean keep in mind I was just a 24-year-old, giving my opinion. I wasn't trying to convince them, but I said, 'Okay, sure.'"[8]

Proestakis called Brandon Fisher, owner of Centerrock, Inc. Fisher and Centerrock had been part of the rescue operation at Quecreek, and when Fisher learned about the San José accident he had made contact with the Chilean government through a federal trade office in Pennsylvania that had an office in Chile. Fisher had been in touch with the off-site consultant team in Santiago for two days prior to Proestakis's call. Fisher recalled:

> I had been talking to the engineers in Santiago about our company, technology, and experience, and had been asking them questions about the rock hardness, logistics, etc. at San José. When Igor called me it was really timely. He became our pivotal point person in Chile

because he knew our technology, spoke English very well, and knew the culture and business practices of Chile.

Proestakis commented, "I called Brandon and told him about my conversation 20 minutes [earlier], and we decided to become a team and work out the details." Proestakis and Fisher worked over the phone and put together a proposal for Sougarret. Proestakis recalled, "Cluster hammer technology had never been used in Chile before, but we thought it could work here, because it works very well on hard rock. Also, it uses multiple hammers, so if one hammer fails to push through, it can always be replaced. We estimated it could bring the miners out in 45 days."

A disadvantage was that the technology had not been proven to drill holes larger than 38 centimeters at depths greater than 300 to 400 meters. Sougarret, nevertheless, asked Proestakis to prepare a presentation for him that he could share with Minister Golborne. Proestakis recalled, "Sougarret was incredible. If you look from his side, this was probably the most important job of his life, and despite my experience and age, he listened to me, asked questions, gave it a chance."[9]

The off-site consulting team had already been exploring Fisher's technology and, with Sougarret's further input, evaluated and promptly recommended Plan B. Proestakis received a call from Sougarret informing him that his proposal was now Plan B. Officials from the Chilean embassy in the U.S. called United Parcel Service (UPS) to expedite delivery of drilling equipment from the U.S. to Chile. UPS delivered about 13 tons of equipment to Chile within 48 hours, with the UPS Foundation covering the shipment cost. To power the cluster hammer drill head, a Schramm T-130 was provided by Geotec Boyles Bros., a joint venture between a Chilean and American drilling firm. Geotec contacted its American affiliate, Layne Christensen, to find drillers who had experience with the cluster hammer technology integral to Plan B. Meanwhile, Fisher and Richard Soppe, Centerrock's director of construction and mining tools, caught the next flight to Chile.[10]

Plan C

Sponsored by ENAP, Chile's state oil exploration company, Plan C used a Canadian-made 500-ton oil rig, called RIG-422, that could drill to a depth of over 3,000 meters. Warehoused north of San José, the oil rig's delivery and installation times would not allow operations to start until mid-September. Unlike Plan A and B, Plan C would not enlarge prior holes but rather, it would drill a wide hole to the miners from the beginning. The rig was capable of drilling up to 1,000 meters a day, but on a terrain much softer than San José's.[11] Additionally, oil exploration usually aimed at an area of over 50 meters, leaving the oil rig with ample room for deviation. In contrast, the San José rescue would require a margin of error of no more than four meters.[12] Despite the more optimistic timelines provided by Plans B and C, Sougarret maintained that a rescue should not be expected sooner than November 2010.[13]

Below Ground: Days 18–28

Initially, the miners were given a purely liquid diet to avoid overburdening their metabolic systems. The health professionals managing their care sent basic hygiene kits and medicine to treat skin ailments. The miners reported that their daily schedule during the past 17 days had consisted of three eight-hour shifts (7:30 a.m.–3:30 p.m., 3:30 p.m.–11:30 p.m., and 11:30 p.m.–7:30 a.m.), each staffed by 11 miners, including a leader reporting to Luis Urzúa. The health professionals did not change the miners' daily schedule but added a set of chores to the shifts, including managing phone lines, monitoring air quality and temperature, receiving meals and emergency food stocks, reinforcing mine walls, and diverting seeping water. Miners retained the roles and responsibilities

they had developed during the 17-day ordeal. For example, Yonni Barrios continued to serve as a medical advisor and administered vaccinations to the miners.[14]

Media interest in the miners' personal lives was rising daily. For example, Barrios was increasingly being discussed in the news, not for his medical expertise, but for whether he would choose to go to his wife or to his mistress upon rescue. During this time, Dr. Alberto Iturra, the chief psychologist above ground, decided to screen letters sent by miners' families, and even withhold some of them. He wanted to censor news that could increase the stress level of miners. However, the miners soon became suspicious as they began to find deleted words and mismatched handwritings in their letters.[15]

Meanwhile, President Piñera spoke with Urzúa to hear a firsthand account of the miners' status underground. As Urzúa narrated their experience, he also agreed to shoot a video for the government to capture the miners' living conditions (see **Exhibit 1** for more on the miners' underground environment). The carefully edited video was broadcast on Chilean national television on Friday, August 26, 2011, during prime time and sent a positive message about the state of the miners. Three days later, on August 29, brief (one-minute) phone calls were arranged between the miners and their families. Dr. Iturra monitored the calls. Having given the government officials and health professionals much of their waking hours, the miners were angry about the short duration of the calls and the intrusive presence of Dr. Iturra. To make matters worse, the families and miners had now confirmed their suspicions that their letters were being screened.[16]

Above Ground: Days 29–36

Camp Hope's population had climbed to over 500 people. In addition, 300 professionals were now working on the rescue operation. Sougarret and Aguilar continued to brief the family members and press of their progress, as they had during the search period. They also held daily morning meetings with the rescue workers on-site to review progress.[17]

In the first week of September, Fisher and Soppe arrived at San José. Fisher recalled his initial reaction: "This was without a doubt going to be the most technically challenging hole I have ever had to drill." Rock hardness was not the issue for Plan B; instead, an initial survey of the pilot hole showed that the hole was very crude, with substantial deviations from the ideal vertical orientation. Fisher explained:

> The existing hole was drilled at an 80-degree angle and twisted and turned a lot and ended almost vertical at 89.5 degrees. At the bottom of the hole our tool would be drilling a vertical hole, but our system would still be mounted at an angle, which meant a lot of side load, which makes everything very complicated.
>
> Using an existing hole guaranteed reaching the miners but posed a huge challenge with all its angles. There were places where there was a 4-degree change in 10 meters, which is unthinkable for drilling, especially when you expand the hole to 71 centimeters—for drilling a hole that diameter your drill system is larger and less flexible. It is meant to drill vertical holes.

Further, the equipment for expanding to holes greater than 38 centimeters had previously been used at a depth of 320 meters. Fisher added, "Expanding to 28 inches [71 centimeters] was a completely new territory." Nevertheless, they began drilling.[18]

On day 36, September 10, only four days into drilling, Plan B suffered a major setback. At a depth of about 260 meters, one of the drill bits broke, and about 30 kilograms of metal got stuck in the pilot probe hole. No further drilling could occur until the broken piece was extracted. The Plan B team tried extracting the metal using a magnet, but failed despite multiple attempts. To extract the broken bit, four different extraction tools (also known as fishing tools) were tried, but all of them failed too. Meanwhile, Plan A was also temporarily halted to fix leaks in a hydraulic hose, and Plan C was still not operational. With no other existing pilot probe holes to spare in which Plan B could initiate drilling, Minister Golborne and Sougarret seriously considered abandoning Plan B altogether.[19]

Below Ground: Days 29–36

The miners were beginning to find their daily chores monotonous. With new access to a mini-projector, many miners preferred to watch television or movies rather than doing chores. Discipline gradually declined alongside their humility as the miners began to digest the news of their celebrity status around the world. Fights occurred about which channels to watch. Distressed by this, Urzúa complained about the constant access to TV in his daily calls with above-ground health professionals. The miners largely ignored Dr. Iturra's recommendation of sticking to the established daily routine; many were still upset at his intrusion into their communications. Dr. Iturra then implemented a system of rewards in exchange for following the orders, but the miners became even more outraged about being treated as children and boycotted his daily sessions.[20]

Above Ground: Days 37–48

With many losing hope for Plan B's resumption, Proestakis had a new idea to extract the broken drill bit with a tool called a "Spider." The Spider had various metallic legs that, in theory, could be lowered into the pilot probe hole and, at a determined depth below the stuck piece, its jaw could be clasped around the remnants of the broken drill so as to extract it. Proestakis commented, "While we were trying different ideas I thought about a tool called a Spider and asked a welder if he could work on it. We designed three different Spiders, exactly the same. Every one of them was able to fish little pieces, and the last one fished out the biggest one." (See **Exhibit 2** for details). The Spider plan worked, and after five very difficult days of unsuccessful trials, Plan B was up and running again. Proestakis recalled, "That was a very difficult time because a lot of people stopped believing in Plan B, and there were talks about shutting it down. I tried not to worry about all that and stay focused."[21]

In the meantime, Jeff Hart and Matt Staffel were handpicked by Layne Christensen to run the Plan B drill system. Hart and Staffel flew to Chile from Afghanistan, where they had been drilling water wells for American troops. Both had extensive experience with cluster hammer technology. Some Plan B team members believed that Hart and Staffel were simply the best drillers they had ever known, with deep practical expertise in how the technology worked. Staffel and Hart would work in 12-hour shifts, with Staffel on day shift and Hart on night shift. By day 44 they had widened the pilot hole from 14 centimeters (5.5 inches) to 31 centimeters (12 inches). Widening the hole to 71 centimeters (28 inches) required larger, less maneuverable hammers. The widening would also produce large amounts of cut rock that could not be brought to the surface. Fisher explained, "Unfortunately, what we had available did not have the hoisting power to bring all the cuttings to the surface. The only option was to let the cuttings fall through the base of the hole." The trapped miners were recruited to help with moving the fallen rock at the base of the hole. Fortunately, the miners had the equipment and enough fuel to remove the falling debris.[22]

On day 45, the Plan B team began widening the pilot hole from 31 to 71 centimeters (12 to 28 inches). At the same time, Plan C commenced operations. Many placed bets on the third plan, including Minister Golborne. As for Plan B, widening the pilot hole would soon become a constant challenge. Fisher explained:

> There was just so much wear and tear that we were drilling about 50 meters between drill bit changes. The drill bit life ended up being far shorter than expected. The deeper we went, the more angles and turns there were, which made it even more time-consuming to be pulling the system, changing drill bits, and pushing it back into the hole.

Soon, Plan C struggled to make headway. The Plan C drill system was meant for penetrating softer rock. Despite its massive thrust, it could not speedily cut through the hard rock that entombed the miners.[23] By day 48, September 22, Plan A had drilled 366 meters, Plan B was widening its 31-centimeter (12-inch) hole and had reached a depth of 85 meters, and Plan C had drilled 40 meters.[24] Although each group hoped to be the one that reached the miners first, a spirit of cooperation dominated all three plans.

As the plans progressed, the design for the three rescue capsules was sent out for construction; delivery of the capsules was expected within two weeks. Aguilar left San José to assist with capsule construction at a Chilean naval base. Fluent in English, Aguilar was to manage the transition between capsule design and construction and to serve as an interface between groups involved in making the rescue capsule.[25]

Below Ground: Days 37–48

Around day 42, the miners saw Dr. Iturra on television stating that the opinion of miners' families did not matter since the miners were under his guidance. Angry, the miners called political authorities to complain about Dr. Iturra, threatening a hunger strike if Dr. Iturra did not change his approach.[26] The government lacked the authority to give direct orders to Dr. Iturra, who had been hired by the workers' health insurance company.[27] Dr. Iturra considered the miners' animosity towards him cathartic for them. Nonetheless, Dr. Jorge Díaz (the doctor overseeing the overall rescue operation) encouraged him to take some time off. Dr. Iturra agreed to do so, and Claudio Ibáñez, a psychologist and an assistant to Dr. Iturra, took interim charge.[28]

In turn, Ibáñez lifted many restrictions, and the miners began to receive uncensored letters. Some letters brought potentially disturbing news. For instance, one miner learned that his secret lover was pregnant. Furthermore, family members now managed to smuggle miners' cravings in their personal packages to their loved ones. For instance, some miners received drugs, and as they huddled in a bathroom area to smoke marijuana, they left others upset that they had been excluded.[29]

For the Chilean Independence Day (September 18), the government asked the miners to participate in an event, and they agreed to do so. After the cameras were turned off, most felt like actors—not authentically themselves in these public events. Soon, media expert Alejandro Pino volunteered his services to provide the miners with media training. Pino advised the miners to take advantage of their celebrity status and agree to media opportunities. After their experience with Dr. Iturra, some miners distrusted Pino. Others confided in him.[30]

Above Ground: Days 49–66

Plans A and C continued to make slow headway, and Plan B, although advancing at a faster speed, kept hitting challenges. Fisher noted, "Every hour of every day we had something throwing a challenge at us. We knew our technology well, but we were constantly facing one problem or another—a broken drill bit or loss of pressure. An added frustration was communication and working in a different culture." Leaving the site only every few days to get a shower and getting less than three hours of sleep a day in an on-site metal shipping container, Fisher, Soppe, and Proestakis worked through each challenge as a team. They could all communicate in English and were familiar with the technology. Fisher commented, "Fear of failure was always at the back of our heads, but our team dynamics were great. We hit it off really well, and we decided that we would face every challenge that came our way and try to solve it, and if it didn't work we would learn from it and develop another solution." Proestakis recalled, "Brandon, Richard, and I were a great team. Anytime we ran into problems, we started working, the three of us. Brandon would call his engineering team in Pennsylvania, and we would exchange ideas." Fisher concurred: "We would troubleshoot, communicate, and then the challenge was to communicate to the Chileans because we had to explain how to fix something that broke on our equipment, and that makes others second-guess you. You propose your ideas, but you also have to show why other ideas won't work on this system." Proestakis added, "When problems arose, we focused on how to fix it. There is no point crying over spilled milk—it takes time away from solving your problem. You just sit down, grab a piece of paper and pencil, and sketch out ideas."[31]

Véliz and Matthews were officially in charge of Plan B. Along with Sougarret, they had to approve all decisions. They advised and helped members of Plan B as needed and whenever possible. For instance, Matthews and Véliz made a complete profile of the hole with a detailed assessment of the nature of the rock Plan B faced all the way down to the refuge. This created a kind of map that helped the team make detailed execution decisions. Further, Plan B team members deeply admired Sougarret and valued his ability to make good decisions quickly and to leverage his network to expedite delivery of needed resources. He was perceived as a great listener, a team player, and as someone who allowed others to experiment with good ideas.[32]

Meanwhile, a lawyer representing all but three miners' families filed a suit against the government (for US$27 million) for reopening the San José mine. Details of past congressional hearings dating to early 2001 surfaced; the issue of productivity appeared to have been a key argument in favor of keeping the mine open. At the same time, the reaction toward government efforts in the current rescue was becoming mixed; some criticized government officials for using the situation to its political advantage, while others felt sure that the rescue would not have happened at all under another government.[33]

By the first week of October, all three plans were struggling. Plan A was halted for three days because the team had to change its drill bit. Plan B had to stop to replace a hammer. Plan C had veered off course and needed to reposition the drilling—a huge challenge given the size of the Plan C system. In the meantime, Sougarret decided to survey the vacant drilled holes to determine whether their walls would need a metal lining to allow for a safe passage of the rescue capsule. The capsule would have to travel almost nine times the length traveled in the Quecreek rescue, and do it over a rough surface. Survey results showed that the tunnel was not uniformly rough and in some places was almost glassy in its smoothness. The question was whether or not the entire length of 700 meters should be lined. The decision to line the entirety of a drill hole would add up to 10 days to the rescue timeline, posing a trade-off between safety and speed.[34] Meanwhile, Aguilar and the government officials focused on the logistics of the rescue.[35]

As Plan B resumed drilling, three rescue capsules arrived at San José. The capsules weighed 419 kilograms, measured two meters high, and were painted the colors of the Chilean flag. Tests of the capsule began soon, while it was accessorized for communication systems. Meanwhile, by October 6, Plan B was less than 50 meters away from the miners, and it seemed likely that it would reach the miners first. Sougarret decided not to make any premature announcements. Many factors could threaten success at any point—ranging from earthquakes (to which Chile was historically prone) to another cave-in (a significant possibility due to instability caused by the initial cave-in) to ordinary breakage of equipment (already an ongoing challenge). Sougarret had seismic activity sensors placed inside the mine to provide early warning of a tremor or cave-in.[36]

A decision about the metal casing had to be made soon. Geologists, drillers, and engineers met and articulated three options: no lining, partial lining, and complete lining. To optimize time and safety, Sougarret decided to line the roughest portion of the Plan B hole—the first 100 meters.[37] Meanwhile, experiments on the rescue capsules showed it would take about 90 minutes to rescue each miner, which meant up to two days to rescue all the miners. Each miner had to have his medical needs attended to as soon as possible. Two miners needed immediate dental surgery; another, who had attempted suicide a few years earlier, was thought to need immediate psychological help; and yet another suffered from bipolar disorder. Therefore, as each miner would make it to the surface, an on-site clinic would examine him. If a miner was approved for flying, a Chilean Air Force helicopter would fly him to the Copiapó hospital, replacing a 60-minute drive with a 10-minute flight.[38]

On October 8, the Plan B drill was less than 10 meters from the miners. As Hart slowly lowered the drill into its target, the metallic roof lining of one of the tunnel ceilings got entangled into the hammer bit. Pedro Cortés, one of the miners, explained what he saw to the engineers above ground via telephone. The engineers translated Cortés's field report for Hart, who then decided to grind through the metal. Hart carefully manipulated the drill's speed and pressure. As the screeching sound of metal cutting metal ended, Plan B made its breakthrough at 8 a.m. on October 9, 2011.[39] Sougarret made the long-awaited announcement of a breakthrough and explained to the miners' families and to the press the plan to line the rough portion of the pilot hole over the next two days.[40]

Below Ground: Days 49–66

Below ground, discipline had lapsed under Ibáñez's laissez-faire approach. Miners did what they wished; some started running regularly through the tunnels despite the serious risk of harm from the rough terrain. Ibáñez caused another stir among the miners when he brought a journalist to one of his video conferences with them. The miners called Aguilar in their anger. Ibáñez was discharged and Dr. Iturra returned, ostensibly with a new attitude; he released all the letters previously held back, leaving the miners with about 300 letters to sort through and read.[41]

Dr. Jean Christophe Romagnoli, an advisor to Chilean armed forces and professional athletes, prepared the miners for the rescue capsule. The miners were asked to jog two kilometers every day while singing to ensure their heart rate did not exceed 140 beats per minute. The miners liked Dr. Romagnoli—for one, he had granted requests for cigarettes. The miners' behaviors, however, oscillated between extremes, indulging in petty fights over cigarettes one minute and promising never to break their fraternal bonds another minute. Many had difficulty sleeping, due to both anticipation and the drilling sound, and they were given prescription sedatives. By day 63, they were asked to start packing and to send personal items above ground. Three days later, the upper portions of the mine experienced a cave-in, producing a loud, cracking sound that led to a frantic call from Urzúa to Sougarret. As the sound subsided, the miners tried to collect themselves. In the following days, the miners asked for more and more cigarettes, and Dr. Romagnoli obliged them.[42]

Days 67–70

Plans A and C were halted, with Plan A having completed 85% and Plan C having finished a little over 60% of its intended drill depth. Given the progress of the metal lining of Plan B's hole, October 12 was set as the day the rescue would begin. Health officials, in collaboration with the government, decided that Urzúa would be the last to leave because he was the shift foreman. Florencio Avalos would be rescued first because he was most fit and known to handle technical glitches with calmness.[43] Many miners, however, wanted to be the last to leave, in part to hold the world record of the longest time underground. Shortly thereafter, the officials at Guinness announced that the record would be awarded to the group as a whole. The miners also wanted to leave San José together as a group. Although the medical team refused to delay medical attention to the miners, they prepared a fleet of ambulances on-site in case the scene at the surface played out the way the miners seemed to want. President Piñera was advised not to allow cameras up close to the rescue, but he considered it necessary to share this remarkable story with the world. Subsequently, a camera was hoisted atop the drill hole to capture each miner's ascent to freedom.[44]

As rescue gear was sent below ground, rescue professionals above ground rehearsed emergency protocol with the miners. Each miner's vital signs were to be monitored throughout the ascent, and if anyone showed signs of a panic attack, the entire operation would be halted until he recovered. The overall health of the miners in days approaching the rescue raised some concerns—one of the miners was having breathing difficulties, another had not taken stress-relief medicine, and yet another had a severe toothache. Barrios had been so stressed due to the exposure of his personal life in the media that, like others, he had altogether stopped carrying out his medical duties. Nevertheless, the miners engaged in tasks they considered relevant to survival; for example, they blasted a portion of a tunnel to create a smooth entry point for the rescue capsule.[45]

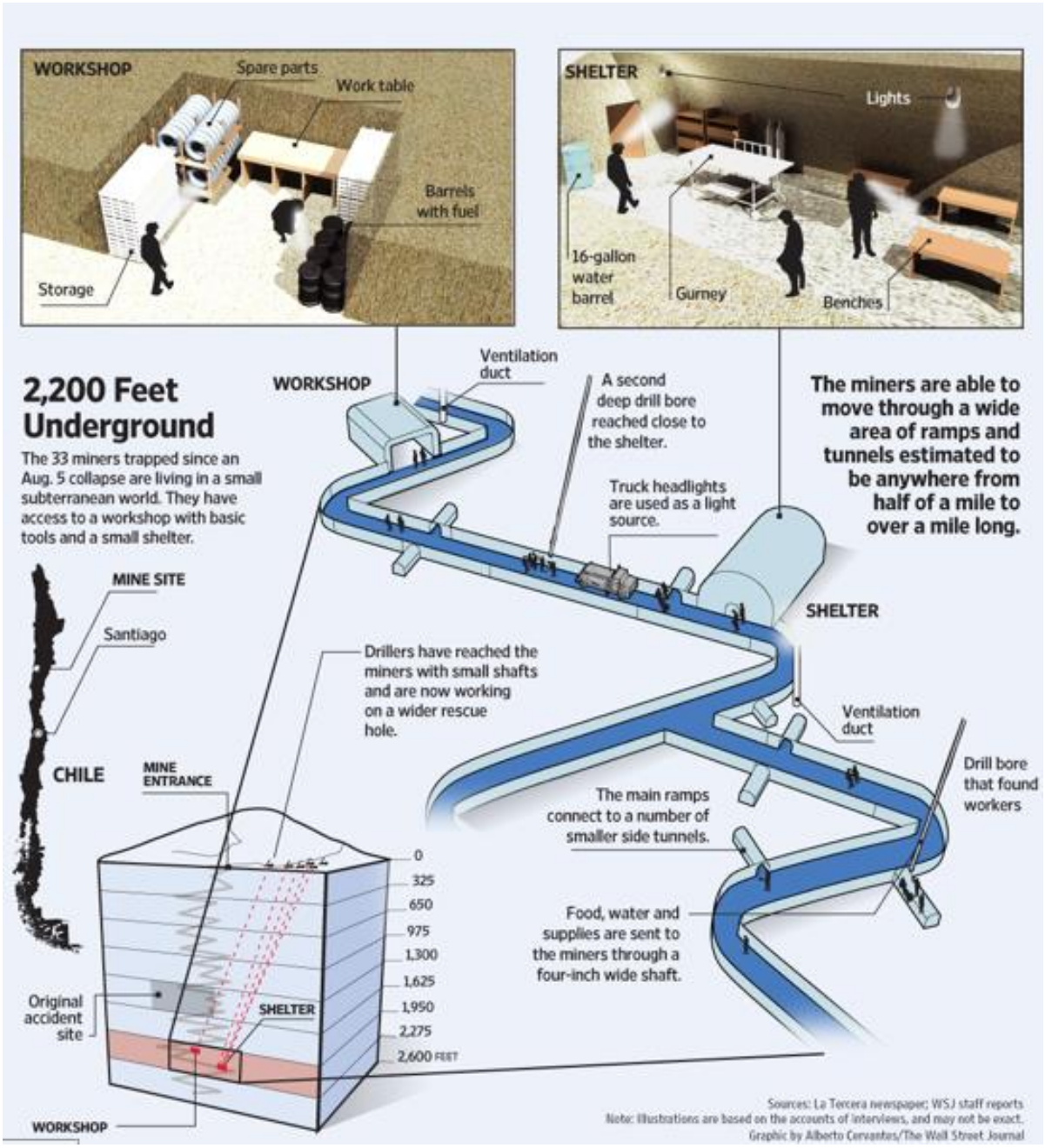
Miners could not eat anything for 12 hours before the rescue and had to wear a girdle to shrink their body size to fit into the capsule easily. They were briefed on what to expect above ground—a short meeting with family members, President Piñera, and Minister Golborne, after which each miner would be taken to a field hospital.[46]

At 8 p.m. on day 69, October 12, President Piñera and First Lady Cecilia Morel arrived at the San José mine. Chilean Air Force helicopters finished the practice runs between San José and Copiapó hospital. The escape capsule trial run with 80 kilograms of sand completed the round trip in 30 minutes. Only the Chilean national television was allowed live coverage of the event, and the government retained control of what the estimated one billion viewers around the world would see.[47]

At 11:53 p.m., the first miner began his nearly 20-minute ascent to freedom, emerging at 12:12 a.m. to the cheers of the crowd and to hugs with family members and President Piñera. Over the next 22 hours, all miners were rescued. The operation that cost about US$20 million[48] and the cooperation of hundreds of professionals, experts, disciplines, government agencies, industries, and organizations from around the world came to a definitive—and successful—end.

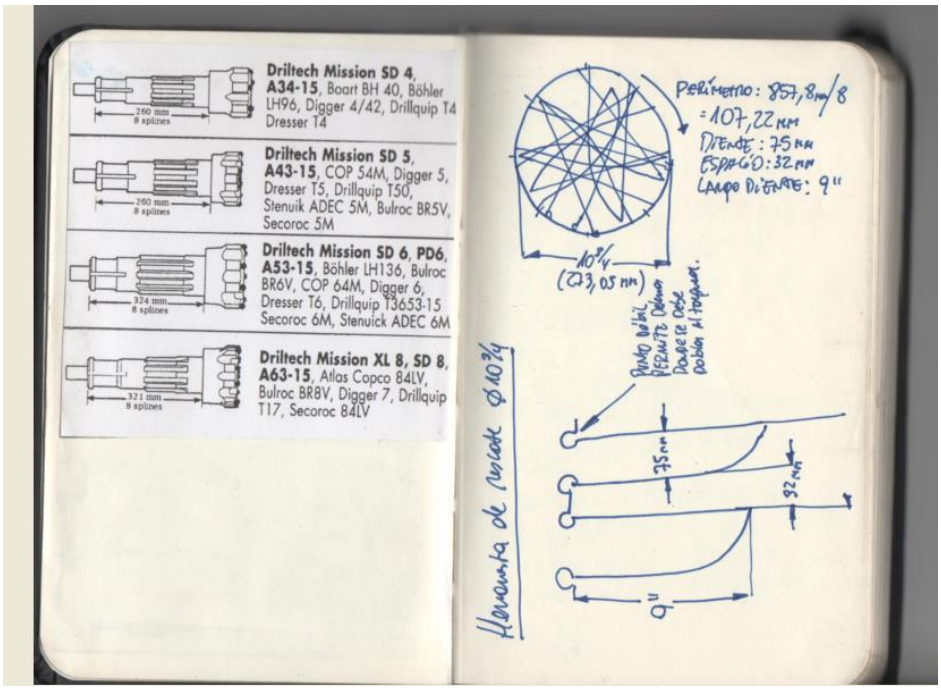
The long-term recovery of the miners from their traumatic ordeal, however, remained an open question.

Exhibit 1 Miners' Underground Living Environment



Source: The *Wall Street Journal*, http://online.wsj.com/article/SB10001424052748704147804575455511399879190.html, accessed November 21, 2011.

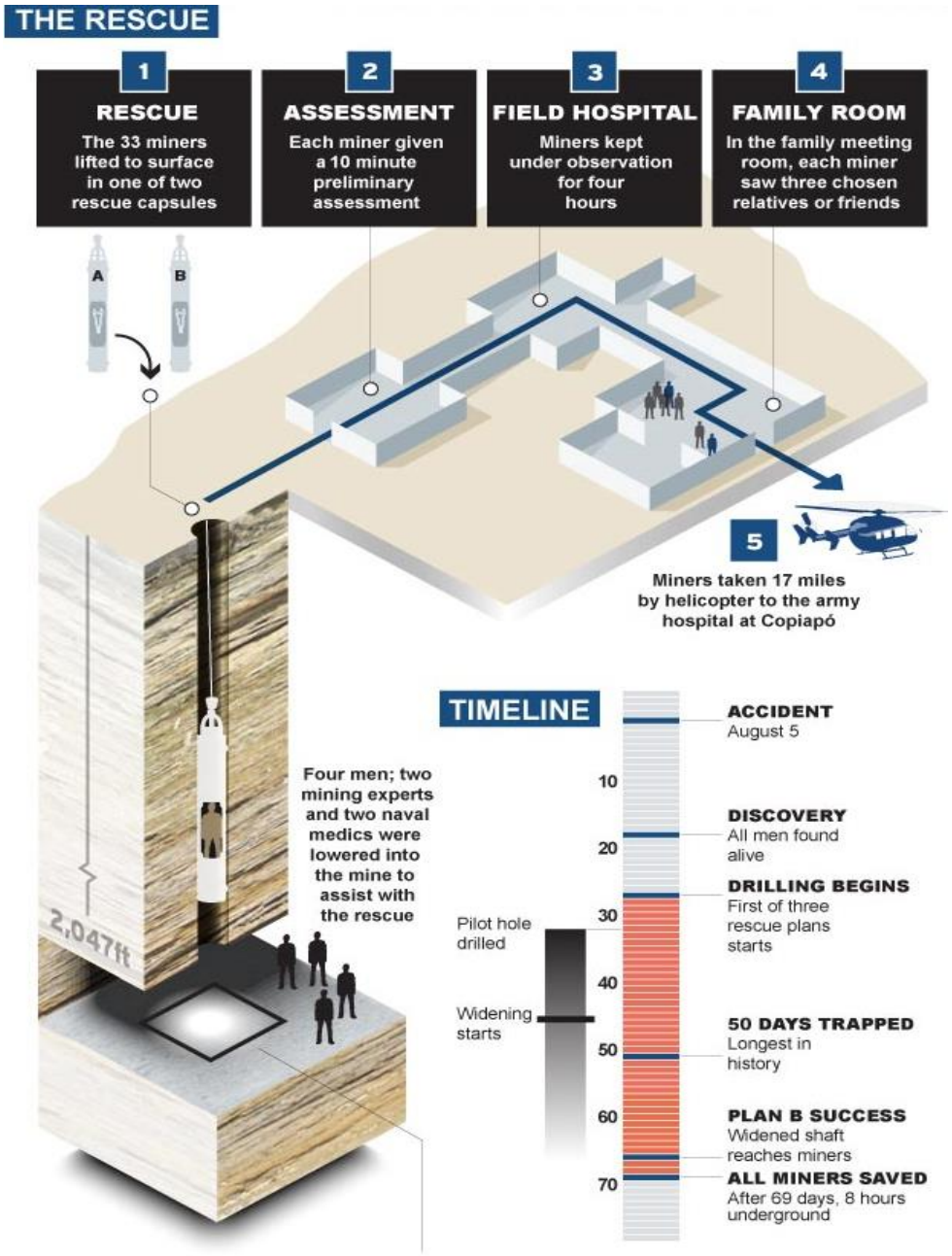
Exhibit 2 Plan B Schematics for Retrieving the Broken Drill Bit



Source: Plan B team member personal notes during the rescue.

Note: The tool, with an open claw, was lowered into the drill hole where it closed to secure the broken drill bit. The tool along with the retrieved broken drill bit was then pulled back up.

Exhibit 3 Rescue Overview



Source: "Chilean miners trapped in San Jose mine," *The Telegraph*, http://www.telegraph.co.uk/news/worldnews/southamerica/chile/7961923/Chilean-miners-trappedin-San-Jose-mine.html, accessed October 14, 2011.

Endnotes

[1] Interviews by casewriters, January 27, 2011; March 9, 2011; and March 16, 2011.

[2] Jonathan Franklin, *33 Men: Inside the Miraculous Survival and Dramatic Rescue of the Chilean Miners* (New York: Penguin Group, 2011).

[3] Ibid.

[4] Interviews by casewriters, January 27, 2011; March 9, 2011; and March 17–18, 2011.

[5] Interviews by casewriters, January 27, 2011; March 9, 2011; and March 16–18, 2011.

[6] Interviews by casewriters, March 17–18, 2011.

[7] Interviews by casewriters, January 20–21, 2011, and March 5, 2011.

[8] Ibid.

[9] Interviews by casewriters, January 21, 2011; March 16, 2011; and April 1, 2011.

[10] Interviews by casewriters, January 21, 2011; March 16–18, 2011; and April 1, 2011.

[11] Interviews by casewriters, March 17–18, 2011.

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[22] Interviews by casewriters, January 20–21, 2011, and April 1, 2011.

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[28] Franklin, *33 Men: Inside the Miraculous Survival and Dramatic Rescue of the Chilean Miners*.

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[37] Interviews by casewriters, March 5, 2011, and March 16–18, 2011.

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[40] Interviews by casewriters, March 5, 2011, and March 16, 2011.

[41] Franklin, *33 Men: Inside the Miraculous Survival and Dramatic Rescue of the Chilean Miners.*

[42] Ibid.

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[44] Franklin, *33 Men: Inside the Miraculous Survival and Dramatic Rescue of the Chilean Miners.*

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