Chuquicamata: Monitoring one of the world's largest underground mines

Country
Chile

Project type:
Underground

Sector:
Mining

Main product:
Monitoring Solution

Challenge

However, block caving presents several potential geotechnical hazards. For example, in-situ loads change constantly and, in consequence, so do the demands on the local support and reinforcement systems. This is in addition to over stress, ground deformation due to excavation, rock detonations, and other events that will affect the safety of the mine. Hence the importance of employing geotechnical instrumentation to monitor the different safety variables of a rock mass, the behavior of the support and reinforcement systems, and other important elements.

Another important challenge is the lack of access to electrical power, since traditional dataloggers require constant power from an external source. Furthermore, getting the data out of the mine is an issue, due to the reliance on wires that can easily be accidentally cut, as well as the lack of access to communication nodes that can deliver the data outside the mine.

These were some of the challenges facing Chuquicamata when it began underground mining operations. Codelco entrusted this task to its geotechnical and structural monitoring partner, Geosinergia. Codelco asked for a monitoring system that provided better coverage than traditional solutions, and that reflected the state-of-the-art of modern mining technology. The goal was to deploy a system capable of covering the vastness of Chuquicamata, keeping its operations safe, efficient, and without interruption.

Solution

Geosinergia and Worldsensing have deployed underground wireless monitoring networks in several mines. In particular, the Chuquicamata project is currently the largest and most modern underground mining monitoring project in the world.

Chuquicamata's installation is based on Worldsensing IoT remote monitoring solution, employing long-range, low-power LoRa networks that wirelessly connect battery-operated devices as part of Internet of Things (IoT) deployments. The installation uses Worldsensing low-power digital loggers connected to a variety of sensors, like extensometers, load cells, inclinometers, clino-extensometers, TDR, and many others, thanks to Worldsensing's best-in-class integration capabilities. The dataloggers collect the data from the sensors and send it wirelessly to via LoRa network. In turn, these gateways transmit the sensor data securely and reliably to Chuquicamata's control center.

With this solution, readings no longer rely on the availability of an external power source, and its wireless nature means that there's no danger of losing signal because of a cut wire. The instruments now provide data that is available daily. Thus, the mine's managers now have prompt readings that help them make decisions regarding reinforcement and support, geotechnical stability, and other aspects of mining safety.

"Chuquicamata is the largest mine in the world. And the challenge is making all geotechnical monitoring systems inside Chuquicamata's several underground mining units fully automated. And in doing so we'll be shifting the paradigm."

Alex Rojas
General Manager
Geosinergia

Benefits

Robustness & Reliability

Worldsensing's devices, with their ease of installation, use of quality components and rugged construction (with an operational range of -40°C TO +80°C), internal batteries that can last up to 10 years, and low-power LoRA technology, can operate for years on end without requiring a maintenance check. This results in a system that requires minimum human intervention. As an example, Vicencio remembers one of their first installations of remote monitoring, in 2016: "One of the [Worldsensing] gateways that we first installed has kept on monitoring for years, without any work done on it. I haven't had to check that gateway since I installed it. This kind of reliability is one of the biggest advantages of this system."

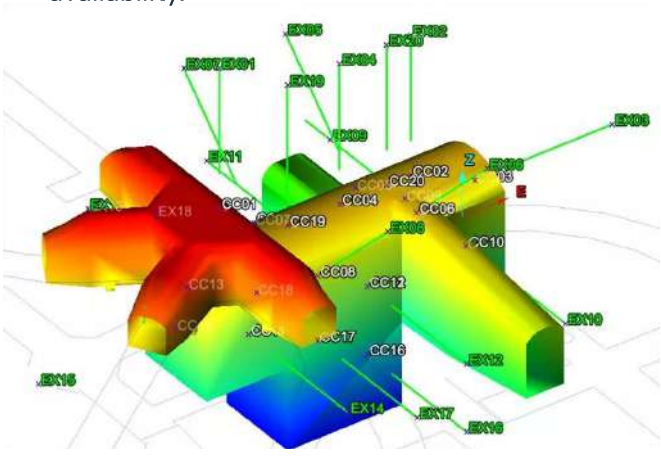
A New Safety Paradigm

The ease of installation, reliability, and lack of wires drive down costs and enable the deployment and support of larger monitoring networks. This increases the safety of large-scale underground sites like Chuquicamata. Its operators can now get monitoring coverage in all parts of the mine, obtaining a clear picture of the conditions throughout the site.

This, in turn, supports the industry-wide shift towards more preventive monitoring. Increasingly, mine safety is no longer just about pulling people and equipment from a dangerous area before an accident happens, or minimizing the damage when an accident happens – it's about not having accidents happen at all. Igor Bravo, Geosinergia's CEO, sums it up: "Nowadays the safety concept is different. We want to anticipate when a large fault is forming, not wait until the radar sees it. Then we can stop that process using other tools. This is what's being asked from us."

Advantages

- The dataloggers are battery-powered and can last up to 10 years with little or no maintenance, resulting in a robust and reliable system that remains operational for a long time.
- Field-proven LoRA technology allows wireless connectivity even while navigating complex underground tunnels.
- Best-in-class integration with monitoring sensors and systems provides compatibility with the specialized needs of underground mining.
- The Connectivity Management software (CMT Edge) offers 24/7 access to device, data, and network information, providing constant data availability.



Software modeling of Chuqicamata's North Macroblock crushing room 02-03. One of the critical underground infrastructures that are under geotechnical and structural monitoring. Here, extensometers and load cells, connected to wireless dataloggers measure the excavation stability to maintain safe operations.