

Remote controlled locomotives 1000 meters under ground

CUSTOMER TESTIMONIAL – LKAB

LKAB, in Kiruna, Sweden, has the world's largest underground iron ore mine—the most modern in the mining industry. Here, you'll find the latest IT systems, and for a long time, the underground transport system has been controlled remotely. At a 1045-meter depth, the deepest part of the mine, communication is managed with Åkerströms' remote control for locomotives. And this solution is part of the system for remote control of driverless trains that transport thousands of tons of ore, around the clock, from the mine shafts.

It's calm and quiet above ground. No signs of the intensive, year-round, 24/7 operation that's running one kilometer below. Large-scale, sublevel caving (a mining method) is needed to run a mine at such depths, while employee safety gets the highest priority. LKAB invested in sophisticated technology early on and thus stays on the leading edge of mining trends. The first remote-controlled, underground transport system started operating already in 1972. Today, a large portion of underground production is automated. Most the production is monitored with computers in the control room, which is at a depth of 775 meters. Increased remote control and automation have led to a much safer working environment.



Remote control provides increased safety

Ore mining literally starts with a bang. First, drilling and blasting remove huge chunks of ore from the underground ore body. Then electric wheel loaders transport the ore and dump it into vertical shafts (ore passes) that lead down to the main level, which is 1045 meters underground in the Kiruna mine. Here, the ore is tapped into remote-controlled train cars that take the ore to crushers. When the ore is crushed into smaller pieces, it's moved onto elevators (skips) that transport it up to processing plants above ground.

"Thanks to remote control and considerable automation, work has become easier and much safer, and fewer employees are needed in the underground operation," explains Lennart Hannu, system technician at LKAB in Kiruna.

LKAB has nine locomotives that operate in the Kiruna mine; six of the nine are run simultaneously. Each train consists of a locomotive and 24 cars that transport a total of about 550 tons of ore. About seven trains per hour empty their loads of ore into crushers, which adds up to thousands of tons in a 24-hour period.



Remotely controlled locomotives work perfectly in mines 1000 meters under ground

Since 1997, LKAB has been using Diracom and Locomote—solutions from Åkerströms. The Diracom system manages communication between the locomotives' automatic train control (ATC) system and the central control system. Using Locomote, the locomotives are manually controlled.

Each locomotive contains an ATC unit that recognizes radio-communication signals and executes all commands. Radio transmitters are placed along the four-kilometer-long underground railroad. Each transmitter continuously feeds data to the train, regarding, e.g., its position. Via the locomotive's ATC unit, data are transmitted to Åkerströms' radio communication solution and then to the central control system that displays the train's location on computer screens. That way, operators have total control of the train.

“Åkerströms' radio communication solution is like a magnet that pulls all data together,” says Hannu. “And its wireless remote control of locomotives works extremely well, even in the deepest parts of a mine.”

A radio mast is at the heart of radio communication; This mast is placed far into the tunnels and is connected to a centrally located computer. Radio waves are transported between the mast and the locomotive through emitting (leaky) coaxial cables that run along the tunnels' ceilings. A leaky coaxial cable is slotted so that radio waves can emit and reach antennas on the locomotives' roofs.

Radio controlled chute loading of ore

Åkerströms' Locomote takes over at the bins where ore is tapped from vertical shafts into train cars. Then control-room operators drive the train remotely. From a computer screen, they simply control the train with a joystick and ensure that the cars are filled with ore. They can drive the train forward and backward, while they open the bin's trap door and release the ore. When the cars are fully loaded, the operator pushes a button and the locomotive's ATC unit takes over again and drives the train to the crusher. Here, the cars are



automatically emptied from underneath and then backed up to the tapping bin for a refill.

“Safety is the most important thing in a mine, and radio communication plus the locomotive's ATC unit, contribute to safety,” says Hannu. “Everything is connected to a warning system that sounds an alarm if something abnormal occurs. Employees need not be close to risky areas such as bins and shafts. Instead, they can control and run the operation at a safe distance.”

Joystick controlled locomotive in the service center

Once a month, locomotives are inspected in the mine's service center. Even here, Åkerströms' solution for remote control of locomotives is used but with a portable locomotive transmitter. This light, easy-to-use transmitter weighs about one kilo and is equipped with a joystick that simplifies locomotive control. Service technicians need not get on board to drive the locomotive. From the shop floor, it takes only one technician to start, steer, and stop the locomotive.

“Remote control of locomotives enables a safer working environment in the shop because locomotive drivers have a full view of everything,” says Hannu. “This solution also prevents knee and back injuries because drivers need not constantly climb in and out of the locomotive. We strive to make mining safer and simpler, and remote control is a natural component in this work. Åkerströms' knowledgeable staff and the excellent partnership that we have together are also very supportive in help us reach our goals.”

