

# SAVING FACE



**Allan Black and James Sudworth, Komatsu, UK,** describe how advanced monitoring technologies are protecting coal workers at the face.

**A**s automation takes on a larger role in the longwall mining process, operators are moving farther from the face and its associated safety concerns. However, fewer operators means that those remaining on the longwall are not always visible to other mine personnel, effectively turning them into lone workers. This lack of visibility is of particular concern if an operator becomes incapacitated. Newer technologies, including powered roof supports (PRS) automation and advanced shearer automation (ASA), are designed to make mines more efficient while enhancing safety. Now personal proximity detection systems are also available to further enhance safety for these lone workers remaining on the face.

## **Leaving the face**

Removing longwall operators from harm's way is a top priority for the industry. Mining equipment and service providers, such as Komatsu, have been working to develop systems to begin the

process of extracting personnel from hazardous areas. One such option is a Remote Management Centre (RMC), an information and control centre situated a safe distance away from the longwall, positioning the operator in a secure environment while still giving them access to critical information, camera images and control of the key components of the operation.

Inbuilt automation of individual components of the longwall system are well-developed and proven by technologies such as PRS automation and ASA, which help facilitate and allow for smooth remote operation. Still, the level of achievable remote operation is largely dependent on the site, as adverse geology and unpredictable seams cannot always be detected during the mining process, meaning the number of manual interventions will rise and fall from project to project. Should an operator encounter an extreme situation, the RMC allows the operator to make manual interventions remotely using the information and images provided.

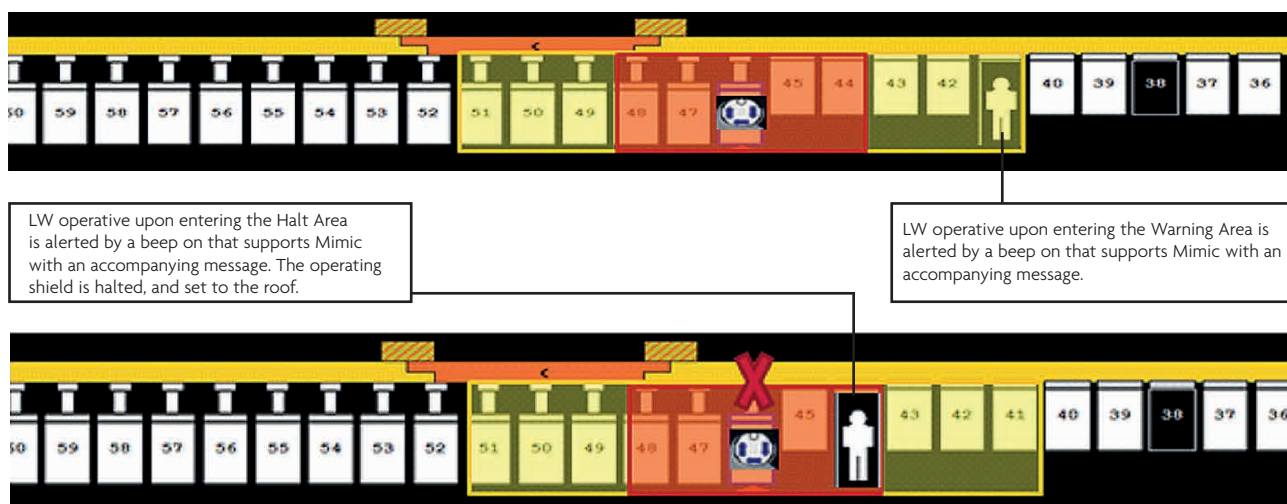


Figure 1. Halt and warning zones are configurable to suit each mine's application.



Figure 2. The tag is supplied in a leather pouch for easy attachment to an operator's belt.

When further interventions are required, personal proximity detection systems then provide operators on highly automated longwalls the confidence that they can enter the longwall in a monitored and controlled environment in order to stop potentially dangerous situations.

It all started with an idea to personalise workplace safety, before long, the proximity detection system was born. The key to the system is an identification tag that is uniquely registered to each use and worn by all personnel on the longwall face. This allows the system to track a person by name or specific job function. The tag transmits radio signals and uses relative RF signal strength, as well as an

accelerometer, to accurately locate the operator's position. This is then communicated over Joy's Faceboss control system for powered roof supports. The radio signals transmitted by the individually identified tag are actioned by the PRS mimic to protect workers against automated advancing shields.

Halt and warning zone parameters give the mine the ability and flexibility to configure the proximity detection feature to best suit their operators and cutting sequences (Figure 1). This feature is designed to assure that if an operator is detected within the halt headway of an advancing shield, the shield will be stopped and set to the roof. In addition, the Faceboss system provides additional protection by allowing operators to pause and restart primes in order to safely pass a hazardous area. The same well-tested feature is used with the personal proximity detection system.

## Core features and technologies

There is a team of technologies that work together behind the scenes to make this complex system a success. MiWi is a wireless protocol that uses small, low-power digital radios based on the IEEE 802.15.4 standard. Placing several receivers near each other creates a high density of coverage that improves fault tolerance and allows multiple range measurements to be taken simultaneously.

Each tag is then fitted with a combination of MEM (microelectromechanical system) sensors. The accelerometer and gyroscope are

used to generate pedometer style information, including step count, distance travelled, and to classify the type of movement, such as detecting if the operator is stationary or walking. Those two then work with a magnetometer to determine the direction of travel (Figure 3).

The tag sends pings periodically and waits for a response. All the Faceboss mimics are fitted with an integrated transceiver that works with the tag to send a report comprising of movement classification, ping power level, step count, distance travelled and direction (collectively referred to as the 'movement vector'), it also sends a signal report. The tag's ping power level is then dynamically adjusted to collect its configured number of responses.

The RS20s PRS control system, for example, has knowledge of the entire longwall system. It can tell how far advanced an individual powered roof support is, the precise shearer location and detect primed roof supports. This combination of information is referred to as the environmental data. Once the system receives the tag signal and movement vector, it combines them with the environmental data to determine the location of the operator on the longwall. It then uses its knowledge of the longwall system, i.e. location of advanced supports, locations of main gate, tail gate, BSL and shearer, to adjust the tag's reporting rate based on the operator's current location. The system can also provide localised audible and visual indication to an operator at their location and prompt

them to interact with the mimic, or pause a primed PRS. Before and during movement of equipment, the RS20 determines if the operation is safe, based on the assigned operator level and type of operation requested. If the action is deemed unsafe, the movement will be stopped.

The individually identified tags are supplied in a leather pouch for easy attachment to an operator's belt (Figure 2). It is recommended that the operator fit the tags to the front of the waist, as this will provide easy access for quick visual checks and personal

comfort. The tag is powered by a rechargeable battery.

Dedicated recharging facilities are provided on the surface of the mine (Figure 4). To assure the operator that the operator's tag is fully-charged and operating properly, a test station is used to both register the tag to the user and test their functionality. A large screen displays the status of the tag and any deficiencies found with the hardware or battery life are highlighted. The administrator will also use the surface test station to update personal information or specific job functions.

## Other applications

Protecting operators from the dangers of respirable dust is another industry priority. Continued developments in personal dust monitoring and dust suppression applications make it easy to see how tailoring the personal proximity detection system to the mine's conditions would further help protect workers. Using a set shearer learning sequence would provide another layer of safety by positioning operators on the clean air side of the machine. The sequence would also allow operators to move throughout the coal face without fear, knowing that if they stray into a controlled dust exclusion zone the longwall equipment will deliver a warning then halt the operation until the operator has returned to a safe area (exclusion zones would be extended and shortened through the longwall as the shearer and powered roof supports were operated [Figure 5]).

## Summary

Using technology to remove people from the face, while still allowing them the capabilities to perform like they are on site, is what mining equipment and service companies are striving for. Creating safer workplaces through innovative technologies, such as the RMC, is making it possible to remove more employees from the face, while personal proximity detection systems add a level of protection for those employees who still need to remain closer to the working area. Couple that with the focus on protecting workers from hazardous respirable dust and it is easy to see that the mining industry is making significant strides in protecting its most valuable asset: the workers. <sup>W</sup>

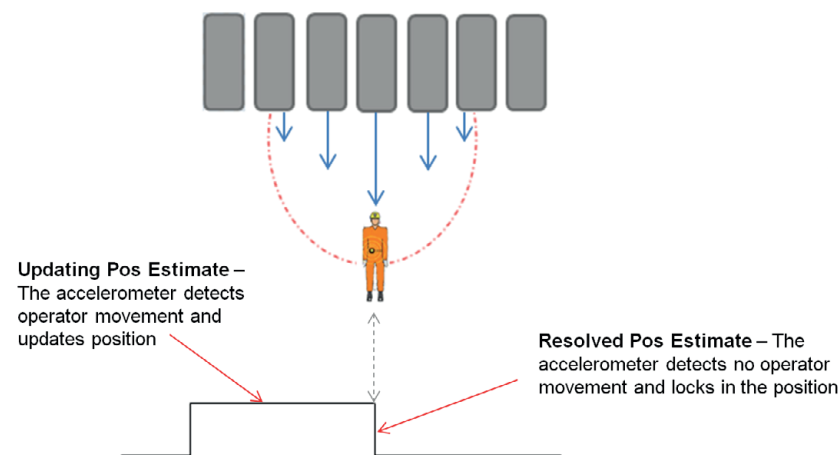


Figure 3. Diagrammatic representation of a step detection using the MEM sensor.



Figure 4. A fully charged tag will last a minimum of 24 hours before needing to be recharged.

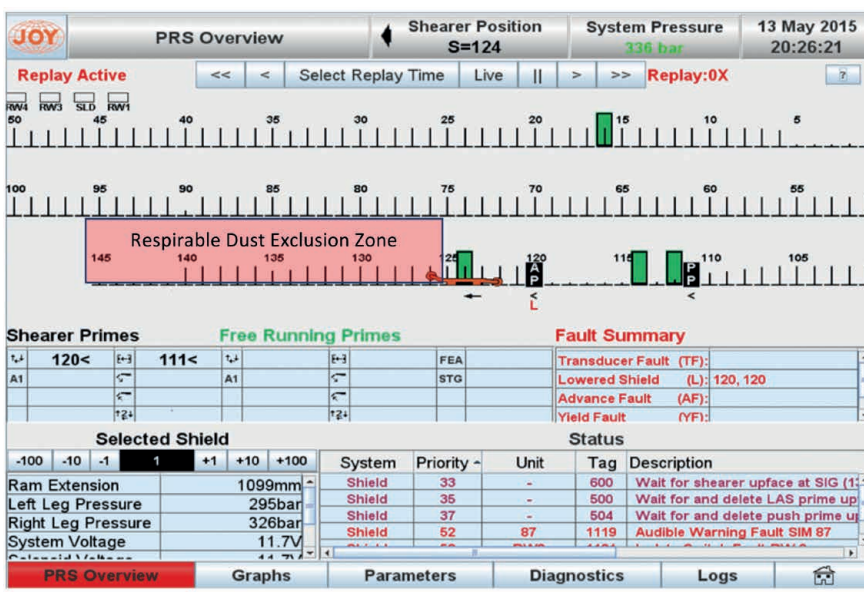


Figure 5. A representation of how the personal proximity detection system would be used as part of a management dust control system.