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How Booyco Use Of Vlf Technology Makes Mines Safer

The application of very low frequency (VLF) technology in the development of underground safety equipment has been an important step towards achieving the mining sector's objective of zero harm, according to Booyco Electronics engineer and developer Frank Schommer.

Booyco Electronics began developing collision warning systems over a dozen years ago, using VLF technology to build a proximity detection system (PDS) for underground mines and becoming a pioneer in this complex field. VLF, says Schommer, is used to generate a magnetic field – based on low frequency technology – around a vehicle, essentially an electric 'fence' which is independent of the material present in the immediate environment.

"In other words, VLF technology allows this magnetic field to travel through obstacles like rock and water, maintaining the 'fence' at a constant distance from the vehicle," he says. "This means that the shape of the fence around the vehicle remains exactly the same, whether the vehicle is underground or on surface."

He notes that the physics of VLF is a well-established area of science and industry and was an important aspect of submarine evolution as it allowed these craft to communicate while submerged as VLF waves can penetrate though water.

"Due to their frequency, the waves are not reflected by walls or other elements of the environment, rather they penetrate these objects," he says. "This allows our PDS to create this invisible fence around mining vehicles at a certain pre-set distance, depending on the specific application and the customers' requirements."

What is vital is that the corners and crossings in an underground haulage will not affect the shape and size of the magnetic field around the vehicle as the waves will penetrate the rock walls and other obstructions that limit what operators and pedestrians can see.

“If the pedestrian is behind another vehicle, for example, or behind a corner in the tunnel, the proximity detection system must be able to pick up and pinpoint their position – and this is what VLF allows us to accomplish so effectively with our PDS solution,” he says.

He describes how the principle of VLF is easily recognisable in daily life, in the case of sound waves from a radio or music playing device. When listening at a distance, it is usually the bass sounds that reach the ear more readily, while the treble sounds – those carried by higher frequency waves – are not; this is because the high frequency waves will be reflected by walls and other objects, so will not travel far.

Surround-sound systems also demonstrate the principle: while there are a number of smaller, higher frequency speakers situated around a room to give the listener the sensation of sound coming from different sources, the system provides only one bass speaker. This is because the behaviour of the lower frequency waves makes it more difficult to sense the direction of their source.

He notes that, despite the advantageous characteristics of VLF waves, it is still a challenging process to actually create a magnetic field to the exacting specifications demanded by safety applications. It requires high levels of power in the transmission antenna to generate the field, for instance, and even in the receiver as well.

He emphasises that PDS, when applied in the sphere of worker safety underground, must ensure absolute stability of conditions so that the performance of the technology can always be relied upon to operate optimally and be fit-for-purpose.

“That is the reason why we have used VLF technology as a basis for our solutions,” he says, “as these waves are best able to deal with the reflective environment in underground workings and maintain fields of a constant size or distance from the source.”

Booyco Electronics’ market-leading innovations have leveraged VLF technology to provide valuable functionality for mine safety initiatives; among the most important of these is the creation of detection ‘zones’ within the magnetic field which trigger specific greater operator warnings and subsequent actions.

“Our technology allows us to define the accuracy of these zones to within very low deviation tolerances,” says Schommer. “For instance, our first zone of safety may be 20 metres from the moving vehicle – and this is accurate to within 10 centimetres.”

When a miner – equipped with a VLF receiver and buzzer unit – enters this zone, the system sends a warning through a flashing light and buzzing sound, to alert them to the fact that they are entering a dangerous area. Importantly, the behaviour of the VLF waves will allow the miner to be alerted even if they are behind a corner or otherwise out of sight of the vehicle operator, when within the detection range.

A second zone, closer to the vehicle, is also set up in the PDS to warn the vehicle operator that there is a pedestrian in the proximity. If the pedestrian does not respond to the warnings and gets even closer, they will enter a third zone which could now trigger the mechanical intervention: switching the vehicle automatically to ‘creep’ mode.

Should the pedestrian enter the last zone defined by the PDS – even closer to the vehicle – then a second intervention comes into play, stopping the machine in its tracks to avoid any possible collision or injury.

VLF PIC 01 : Using VLF technology underground, the Booyco PDS has proved its reliability.

VLF PIC 02 : The Booyco PDS is robustly constructed ensuring its durability under operational conditions.

VLF PIC 03 : The Booyco PDS is robustly constructed ensuring its durability under operational conditions.

VLF PIC 04 : When a miner enters a zone, the system sends a warning through a flashing light and buzzing sound to alert them that they are entering a dangerous area.

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