



Operator Proximity Detection Systems for underground Coal Mines



This system lets Operators stay very close to their Continuous Miner (CM) so their normal, safe operating routine should not have to be modified. However, if an operator accidentally moves too close to any part of the CM his Proximity Detection Device (PDD) will continuously flash a red light warning him to immediately stop the CM or move farther away from it. After a few work shifts the Operator should learn to stay a safe distance away from the CM.

If the operator is detected as being dangerously close to the CM (inside the Red-Zone) then the Coal-Buddy System should shut down the hydraulic pump, disabling the system. Operator detection is achieved as follows:

Two very small MF4 Magnetic Field Antennas (one is shown below on the next page) radiate two magnetic fields around the CM. The strengths of these fields are measured by the PDD which then checks to see if there is a safe distance between the CM and the PDD that the Operator is carrying on his belt.

The PDD 'trip points' at which a warning is shown to the Operator or the CM's Pump is shut-down can be changed in a few seconds. The person making the changes does not have to touch the CM or even be close to it because all of the instructions are transmitted by radio from the Little Genius shown below. Anyone who wants to make any **changes** to the operation of the Buddy System will need the following: a 'Little Genius' unit (shown below), a Supervisor to electronically unlock it for him and the correct 'Security Access Code.'

Note: The LG must only be used in fresh air zones.

Coal-Buddy Proximity Detection System for methane-gas coal mines.

Nautilus Little-Genius

4.8" x 3.2" x 0.8" Fits in a small shirt pocket

This unit can check every piece of equipment even the cables



Nautilus XP-Box on the CM.

Total weight: 12.8 Lbs 11.8" x 9.3" x 4.1" thick
This box contains all Nautilus electronics on the CM



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MF4 Magnetic Field Antenna

Weight: 1.8 Lbs Two installed on each CM.

Proximity Detection Device (PDD) Weight: 0.41 Lbs
Slides directly onto a standard 2" miner's belt



MF4 Antenna (Magnetic Field Radiator)

Two very small MF4 magnetic field antennas are mounted on the CM and each has three layers of protection. The first is that all of the components inside the MF4 are immersed in a liquid which hardens into a very tough solid block. This ensures excellent protection against vibration, shock and water.

The second layer of protection is provided by the high quality Swiss underwater-rated connector which is extremely corrosion resistant and has gold plated contacts. The MF4 can be dropped into a deep pool of water and retrieved without any adverse effects.

The third layer of protection is provided by custom Protection Units. A 1" (25.4mm) thick steel plate forms the base-plate of the unit and more 1" thick plates are welded at each side. 1.3" thick bullet-proof Lexguard plates are added for even more protection with the benefit of only a small increase in weight. This Protection Unit is designed to withstand very large rocks falling on it and should survive even some roof-falls.

Nautilus XP-Box and Proximity-Box

The Nautilus XP-Box is located inside the CM where it is extremely well protected. The Proximity-Box is installed inside the Nautilus XP-Box and contains all of the Buddy electronics on the CM. The Proximity-Box with its red label can be seen through the window of the XP-Box (see previous page) and is sealed to protect it from accidental damage. Because it is a sealed box, the installer or service person needs to know everything that is happening inside the Proximity-Box without removing the seals. This includes the status of the 110vac voltages entering and leaving the box, the status of its radio communications and how well it is functioning. All of this and a lot more is monitored remotely by the 'Little-Genius' unit.

Proximity Detection Device (PDD)

The Nautilus PDD is normally carried by the operator on his miner's belt. It measures the magnetic field strength radiated by the two MF4 Antennas and transmits this information to the Proximity-Box on the CM. The Operator's PDD has a coded red light (LED) on top of the unit which alerts the operator when he is in the Warning-Zone or the Red-Zone. It also lets him know when his PDD only has 12 hours of operating time left. An emergency 'Override' touch-pad on top of the PDD lets the operator override the Proximity-Detection System in pre-approved emergency situations for a maximum preset time period (normally 30 seconds). The operator must keep his thumb on the top of the PDD at all times when the emergency override is activated or the pump will immediately be shut-off.

Little-Genius (LG)

The Little-Genius is an exceptionally smart piece of equipment that can show any person who can push a button the status of the proximity system. The LG allows **anyone** to check the status of all Buddy components without getting close to the CM. For example: if the LG has been electronically unlocked by a Supervisor it will show if the wiring connections to the Joy XP-Box are correct, if 110vac power is being fed to the Proximity-Box, if the 110vac Pump-Feed is available and whether the Proximity-Detection System is functioning correctly. The LG will show the Magnetic Field strength being generated by each MF4 Antenna, it will warn the user if any of the MF4 Antenna cables are disconnected or damaged and tell him which MF4 or cable it is.

The LG will check the battery level of the PDD, show how many hours of operating time are left and show how good the radio communications are between PDD and Proximity-Box and between PDD and LG. The LG can also generate a magnetic field and pretend to be either a front or rear MF4 to check how well the PDD is measuring magnetic field strength. The LG can measure and display the interference generated by the CM's twin VFD drives and allow the installer to compensate for this interference so that a VFD Filter does **not** need to be added to the CM.

LG – Security Codes

A 'Supervisor Code' is required to 'electronically unlock' the LG or it cannot be used by anyone. Once it has been unlocked then the LG can **only** be used to **check** the status or operating condition of the Coal-Buddy System. **No tools are required** everything is done remotely by radio so no time is wasted opening the CM and removing and replacing the many bolts and heavy steel covers. Another benefit is the user can remain a safe distance from the CM during testing.

However, the LG has strict security precautions in place to prevent any **changes** to the system operation. If a person wants to change the Warning-Zone or the Red-Zone he must first have access to an unlocked LG and then he must enter a 'Security Access Code'. For other important functions, a different 'Special Security Access Code' is required.

These 3 security codes allow the Mine Manager to allocate a different code (Supervisor Code, Security Access Code or Special Security Access Code) to different people with different levels of responsibility.

System Updates

As the years pass, Nautilus will keep upgrading and improving its Coal-Buddy Systems and customers with older systems used to be left behind. Nautilus has been designing and manufacturing systems for many different countries for more than 30 years and they solved this problem in 2006. Dealers and occasionally customers are provided with a Nautilus Programming Unit which will update their system software without removing it from the machine. The new software is sent to the customer or dealer by email and it can be downloaded in a few minutes by anyone who knows how to use a computer. Nautilus dealers Repair King Inc. in Shinnston, West Virginia and Minewest Pty. Ltd. (Nautilus Australasia) in Australia and New Zealand already have these Programming Units.

Thank You

Since 2002, Massey Energy, MSHA and Joy Global have worked with Nautilus International to adapt their hard-rock Proximity Detection Systems for use in underground coal mines as quickly as possible. In spite of many difficulties over the years they unstintingly gave their time, access to their best people and provided mines and other test facilities. Without their experience, advice and encouragement Nautilus would never have completed this project.