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Docket: MSHA-2014-0019
Proximity Detection Systems for Mobile Machines in Underground Mines

Comment On: MSHA-2014-0019-0123
Proximity Detection Systems for Mobile Machines in Underground Mines

Document: MSHA-2014-0019-0139
Comment from Matt Crow, NA

Submitter Information

Name: Matt Crow
Organization: NA

General Comment

See attached

Attachments

RIN 1219-AB78 Proximity Comments 9-Apr-17 _ for submission

AB78-COMM-34

JOYGLOBAL

Matt Crow
Global Certification Technologist
Joy Global Underground Mining LLC

April 9, 2017

Mine Safety and Health Administration
Office of Standards, Regulations, and Variances
201 12th Street South, Suite 4E401
Arlington, Virginia 22209-3939

Re: RIN 1219-AB78 MSHA's Proposed Ruling on Proximity Detection for Underground Mobile Equipment

To whom it may concern,

Joy Global Underground Mining LLC is submitting the following comments in response to the Request for Information as documented in the Federal Register, Docket ID MSHA-2014-0019, posted on February 6th, 2017. These comments are in addition to comments previously submitted December 15th, 2015.

General Comments

Joy Global Underground Mining LLC ("Joy Global") would like to take this opportunity to reiterate the comments that it previously submitted on December 1, 2015, in response to RIN 1219-AB78 (MSHA's Proposed Ruling on Proximity Detection for Underground Equipment). Those comments continue to hold true in their entirety. The comments contained in this letter reiterate many of the points that were made in the original response, and also respond specifically to MSHA's new requests for information.

Joy Global's experience with proximity detection systems on mobile equipment, such as coal hauling machines, has shown that while such systems are capable of stopping the equipment prior to contacting a person wearing a personal wearable device (PWD), they cannot be relied upon to stop the equipment in all circumstances. Due to the nature of electromagnetic proximity detection technology, influences from outside sources, such as electromagnetic interference, can prevent electromagnetic-based proximity detection systems from operating as expected, including preventing them from stopping equipment prior to contacting a person who is wearing a PWD.

Today's proximity detection systems were designed for use with various types of section equipment during production operations. They were not intended to stop equipment when maintenance personnel are performing necessary service on a machine (particularly where the maintenance person must be touching the machine for tasks such as adjusting pump pressure

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settings). For such maintenance operations, proximity detection systems should be permitted to be temporarily disabled to allow maintenance personnel to perform their tasks most effectively.

Due to the variety of equipment and mining conditions, warning zones and stop zones should be determined by the mine operators or other responsible persons at each mine, in conjunction with the equipment manufacturer. The appropriate zone configurations for a particular mine will depend upon a wide range of factors, making the utilization of standardized or prescribed zones inadvisable. Mine-specific variables that would affect the configuration of warning zones and stop zones include, but are not limited to:

- Floor material
- The presence of grades/slopes
- Entry width
- Equipment capacity
- Equipment speed settings
- Equipment braking capability

In addition, the presence of electromagnetic interference could require mines to further adjust such zones. Given the existence of numerous mine-specific variables as well as electromagnetic interference, it would be imprudent to prescribe generic zones for an entire fleet of equipment.

In response to MSHA's consideration of implementing a temporary override feature on proximity systems for mobile haulage equipment, Joy Global's experience with mobile equipment proximity systems has shown that such a temporary override or exclusion feature would be required for most mines in order to prevent the continuous mining machine (CMM) operator from inadvertently stopping the mobile equipment during the regular execution of the CMM operator's duties. Such exclusion may not need to be implemented for every load-out, but would be required at sporadic intervals based upon position within a cut or when turning a cross-cut, especially in mines with entries narrower than 18 feet. Without such a temporary exclusion, the CMM operator would not be able to stand in an area with face visibility for many sequences.

While a temporary override exposes the CMM operator to some potential hazards from the mobile equipment, many of these hazards can be mitigated as follows:

- The override must be initiated by the person being overridden (the CMM operator)
- The override cannot be capable of being automatically initiated
- The override must time-out due to time limits and/or function changes
- The override must be capable of being easily cancelled by the initiator
- The override must only temporarily apply such that the CMM operator can only be excluded by the proximity system on only one piece of mobile haulage equipment at a time

Due to the interaction required between the proximity system on the CMM and the proximity system on the mobile haulage equipment, it is recommended that such systems be capable of communicating with each other

In addition, the entire haulage proximity system must have a temporary emergency override function in the event of a proximity system failure that stops the mobile machine in the pathway

of other equipment. Such an emergency bypass must be limited in functionality such that operators do not always run the equipment in this mode.

Joy Global defers to its customers' test sites to provide specific data regarding the level of production interruption introduced by proximity systems on mobile equipment. However, we can say that initial time studies show that proximity systems on mobile equipment result in measurable, permanent reduction in production levels. Production delays are nearly impossible to avoid given the limitations of the current proximity detection technology.

Joy Global's testing of mobile equipment proximity systems shows that nuisance alarms and nuisance stops cannot be completely eliminated. They can be somewhat reduced with sequencing changes (which may introduce other inefficiencies and potential hazards to the mining cycle). In order to minimize nuisance alarms and nuisance stops, it is our recommendation that:

- Miners should remain out of haul ways.
- Miners working in cross cuts to haulage routes should maintain a position far enough into the cross cut to prevent entry into the warning or shutdown zone of approaching haulage equipment.

It is also important to remember that mine personnel located near sources of localized electromagnetic interference, such as power centers, trailing cables, belt drives, VFD pumps, roof bolting machines, etc. (any device that emits an electromagnetic signature within the frequency range of the proximity system) may cause nuisance alarms due to the limitations of electromagnetic-based proximity detection technology. While some sources of interference can be reduced through noise filtering, many sources cannot.

Joy Global's mobile equipment proximity trial-site customers will be able to provide first-hand comments regarding operator situational awareness, as well as the additional hazards introduced due to the use of mobile equipment proximity systems. However, we have observed the following conditions:

- Lack of spatial awareness, leading to positioning in hazardous areas around ribs or roof
- Developing a reliance on the technology, i.e., using the proximity system to stop equipment or expecting the proximity system to stop the equipment for someone in the path of the equipment, instead of taking proactive action to remain outside the shutdown zones at all times, stop the equipment or get out of the shutdown zone

Proximity systems are not a substitute for appropriate mine-provided safety training with respect to the need to recognize, and stay out of, warning zones and shutdown zones. Proximity systems are meant to augment mine-provided safety training, not replace such training. Operators should never rely on proximity systems to stop equipment. Training is most effective when it is both provided in a classroom environment, as well as hands-on in the underground working section.

In response to the request for comments about methods of identifying and mitigating interference sources, the best devices to detect proximity system interference are the components of the proximity system. We recommend that mines test for interference by placing a personal wearable device (PWD) near potential sources of interference and using diagnostic software to observe the existence and effects of interference.

Mine conditions in the vicinity of the proximity system or PWDs which can interfere with the proper functioning of the proximity system include, but are not limited to:

- Metal (including haulage equipment, roof straps, wire mesh, metal tools and other metal machinery and/or metal items)
- Deposits of iron ore or other metal (in the seam, roof or floor of the mine)
- Magnets
- Electric currents
- Electric power sources
- Electronic devices
- VFDs, power cables, communication cables
- Personal Dust Monitors
- Portable electronic devices

The presence of one or more of the foregoing conditions in the vicinity of the proximity system or PWDs can:

- Impair or eliminate the ability of the proximity system to detect a PWD in the shutdown zone
- Reduce the size, or change the shape of the warning zone and/or the shutdown zone without the operator or other mine personnel being aware of these zone reductions/changes
  OR
- Completely eliminate the warning zone and the shutdown zone without the operator or other mine personnel being aware that these zones have been eliminated.

For typical electromagnetic interference from sources other than trailing cables, the best solution is to maintain sufficient distance from the interference source where practicable. However, some sources of interference can be reduced by the use of filtering, screening, etc.

MSHA should consider electromagnetic compatibility testing on new equipment when such equipment is being reviewed for approval by MSHA.

The current electromagnetic-based proximity technology is inherently impacted by ferrous material in the vicinity of the system. When such metals are near proximity components, including PWDs and Drivers/Generators, the measured field strength of the proximity signal can be impacted. The amount of variation depends upon the type, size/shape, and proximity of the material. Such effects cannot be eliminated in today's electromagnetic-based proximity detection systems. To the extent eliminating electromagnetic interference is even possible, such elimination would require significant further development, up to and potentially including the addition of non-electromagnetic-based proximity detection technologies to the current electromagnetic-based proximity detection systems.

Electromagnetic interference that affects the performance of the PWD or proximity system is not always discernable from other signals. Even if interference detection features were implemented, such features could not be relied upon to indicate the presence of electromagnetic interference potentially affecting the PWDs or proximity system. Today's proximity systems are not fail-safe

safety systems, can be adversely affected by electromagnetic interference, and do not always recognize a fault in themselves or shut down when not operating properly.

Again, as discussed in our December 2015 comment letter, the analogy of the automobile collision detection/avoidance system continues to hold. The operator of the mobile machine and the personnel around the machine must first and foremost rely upon their best judgment and training, and not the proximity system, to stay out of the hazardous areas around equipment.

In response to MSHA's request for comments on the testing/checking of warning zones and shutdown zones, since each system has significantly different interfaces and functionality, and each type of equipment requires configuration variations, Joy Global recommends that MSHA allow mine operators and proximity system manufacturers to establish their own recommended testing procedures. Mine operators should always conduct pre-shift inspections of the proximity systems to ensure that they are working as intended.

Joy Global reiterates the comments it has previously submitted in response to the proposed regulation, and submits the comments set forth in this letter as additional comments. Without limiting the foregoing, we call your attention to the fact that as discussed in our December 2015 comment letter, the electromagnetic-based proximity detection systems that are commercially available today will not prevent all collisions between mining personnel and underground mining machines. Instead, today's commercially available proximity detection systems serve as training aids, that together with appropriate mine-provided safety training, help teach mine personnel to avoid certain hazardous areas around underground mining machines. Today's commercially available proximity detection systems may also be fairly viewed as "safety assist" devices, similar to the forward collision avoidance systems and rear collision avoidance systems found on many automobiles. However, just as an automobile collision avoidance system cannot prevent all collisions with other vehicles or pedestrians, today's commercially available proximity detection systems cannot prevent all collisions between mine personnel and underground mining machines. Due to the potential for electromagnetic interference underground, today's commercially available proximity detection systems are even less effective than the collision avoidance systems used on automobiles aboveground. Therefore, proximity detection systems should never be relied on to prevent collisions between mine personnel and underground mining machines. The driver of an automobile with a collision avoidance system remains responsible for being aware of, and taking appropriate action to avoid, potential collisions with other vehicles or pedestrians. Similarly, the operator of an underground mine who has had proximity detection systems installed on the mobile mining equipment used in the mine, remains responsible for providing its personnel with appropriate safety training, and individual mine employees remain responsible for being aware of, and taking appropriate action to avoid, collisions between mining personnel and underground mobile mining equipment.

Thank you for giving us this opportunity to address the subject of Proximity Detection. If further information is needed or clarification of the information presented in this correspondence, please contact me at matt.crow@joyglobal.com or telephone at (814) 432-1573.

Sincerely,

Matt Crow

Matt Crow

cc: Philip Rosenstern