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Proximity Detection Systems for Mobile Machines in Underground Mines

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Proximity Detection Systems for Mobile Machines in Underground Mines

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Comment from Catherine Steinmetz, NA

## Submitter Information

**Name:** Catherine Steinmetz
**Address:**
8031 Merion Dr.
Newark, CA, 94560
**Email:** clemken1974@gmail.com
**Phone:** 5109992256
**Organization:** NA

## General Comment

See attached file(s)

## Attachments

Docket No. MSHA-2014-0019 RIN1219-AB78 Proximity Detection Systems for Mobile Machines in Underground Mines Commentary

AB78-COMM-9

Catherine A. Steinmetz

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University Of Alabama ASEM 616

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Proximity Detection Systems for Mobile Machines in Underground Mines: Support and Commentary

The opportunity to comment on the proposed Department Of Labor Mine Safety and Health Administration ruling "Proximity Detection Systems for Mobile Machines in Underground Mines" (Docket No. MSHA-2014-0019) is an important part of our federal legal process. It also is an opportunity for experienced professionals, myself to provide constructive and practical feedback to our federal agencies to serve to improve standards and support the goal of the ruling, which in this case is to save lives. The comments within this document are derived from professional experience and research in regards to implementing safety and proximity detection systems for automated equipment, mobile equipment, robotics and the like over the course of the past 15 years in large complex manufacturing organizations. The following comments, concerns and proposed improvements to the ruling are made with one intention, which is to support in the prevention of lost lives and serious injuries.

## Proposed Ruling Analysis and Recommendations

### Covered Machinery and Economic Impact

*The Machines Covered and the Economic Impact Analysis* by this proposed ruling are limited to coal hauling machines and scoops on working sections of coal mines and exclude longwall working sections and mobile equipment used on all other types of mines including metal and non-metal mines. The requirements of this section can be improved and potentially have a

greater practical and economical benefit if it is applied in a wide sweeping manner to all mining equipment. Approximately 40 percent of all injuries and accidents in the mining industry are machine related with coal mining leading other types of mines, although sand and gravel mines follow a close second (Ruff et al 5). Mobile trucks including dump trucks accounted for almost half of mobile equipment caused fatalities in all mines (Ruff et al 5). By focusing solely on one type of mine and two types of mobile equipment, this federal ruling by MHSA is limiting its effectiveness and can be more broadly applied to include various types of proximity sensors and apply these to all mobile equipment both above and below ground. This would increase the number of severe injuries lives saved from approximately 11 per year (Federal Register Vol. 80, No. 170 53073) in only coal mines to 80 per year in all mines (Ruff et al 5).

*The economic benefit* of the increase in the prevention of severe injuries and loss of life can be calculated by using the MSHA basis of $9.4 million as the "Value of a Statistical life" as listed in the federal ruling documents and a 40% factor for permanent disability with severe injuries. MSHA uses the total undiscounted benefit as calculated for a 10 year period as $182.6 million, in comparison, if we use the numbers for all mine related severe injuries and fatalities we would see a total economic benefit of approximately $5.1 billion (Based on 60 fatalities and 800 disabling injuries at 40% of the fatality rate over 10 years). Although there is no reliable data available to show the real cost of compliance or cost of implementation due to the sheer number of types of proximity systems and various types of mobile equipment that would need to have a protective device installed on them, using a quantities of scale approach, one could infer that there would be a clear economic benefit of implementing a broad sweeping requirement for all mobile equipment in all types of mining operations.

**System Configuration and System requirements**

The System Configuration and System Requirements which are referenced in the MSHA Federal Rule proposal pose three major challenges on practical implementation which may result in unanticipated of failures after implementation:

- Wearable sensors and worker reliability to use them;
- Defining set up criteria during system configuration;
- Manual override or bypass of the proximity detection system.

Due to the technology available at the present time, all systems that MHSA has proposed as "approved systems" require an operator to utilize a wearable device. This relies on the mine worker to properly wear, position, and maintain a device in order for the proximity system to be effective. To increase the effectiveness to the proposed ruling, an additional method of ensuring that the wearable devices themselves are worn and maintained needs to be included in the ruling. One suggested methodology of ensuring the wear-ability of the device is to combine the reflective clothing requirement (also included in this proposed ruling) and the device technology. By physically and permanently attaching the wearable system component to a piece of reflective clothing such as a reflective vest or integrating into a reflective hard hat which will be required prior to entrance into the mine by mine workers, mine operators will see a lower failure of the system as a whole. The "Failure Rate of a Human" is said to be around 10 to 30 errors per 100 simple routine actions (Sondalini), if this is the case, the chance of a person forgetting to wear a separate device prior to beginning work with mobile equipment would increase the failure rate from 10 to 30 percent. Poor maintenance and the use of battery operated devices can also affect performance. MSHA should incorporate requirements for permanently integrating wearable devices into clothing and create a maintenance requirement for the personal devices themselves.

The maintenance component of the personal device can be included in the pre-shift inspection as mentioned in other parts of this proposed ruling.

The set up criteria for the system itself during system configuration must be developed and standardized per an industry consensus standard. Currently there are other similar consensus standards that are incorporated by reference within federal regulations, one example is the ANSI standard for automatic guided vehicles, ANSI B56.5 (ANSI) and robotics (ANSI 15.06 2012) which follow similar system configuration requirements. These standards document both manufacturer requirements and end user requirements. Allowing the manufacturer and mine operator to freely determine how the system is configured based on environmental influences and allowing adjustability defeats the purpose of the system. As the MSHA rule does mention, the system configurations are performance based and use technical specifications to allow equipment to stop in time prior to colliding with a mine worker. The set-up criteria used to calculate stopping distances of the mobile equipment need to take into account maximum speed and maximum payload. Requiring that these calculation be performed by the manufacturer of the proximity detection equipment in collaboration with the mobile equipment manufacturer would align mobile equipment specifications with the safety system. Requiring standard calculations to be provided by the manufacturer to system integrators and others upon request would help ensure proper functionality. MHSA inspectors and agents could then include these calculations and system configuration documents as part of the required record keeping aspects of the ruling and utilize the referenced specifications as a validation and verification aspect of inspections.

Manual override of proximity detections systems can be allowed but must be restricted by the system administrator or maintenance personnel. This in easily accomplished by a single key

override along with a key management system or password access type system. This is administered by mine leadership personnel and does not increase or change the cost of implementation significantly. By limiting override ability of mine operators the override function can be accessed only be trained personnel. The proposed ruling allows for any mine operator to be trained in the override function. This cannot be allowed and should be a restricted access functionality. Bypassing a safety feature of a machine creates an unanticipated failure mode and has to be treated similarly to other bypass options in other MHSA standards such as lock out tag out requirements and machine guarding. Alternative safety measures need to be implemented and a bypass procedure which incorporates these included in the proposed ruling to ensure consistency and continuity within the MHSA agency policies. Preventing manipulation of a validated safety feature of a piece of machinery is key to maintaining safety reliability.

**Training and Testing Requirements and Proposed Curriculum**

*Training requirements are an integral portion of safety program.* MSHA proposes a new equipment training requirement within the ruling and has solicited comments and suggestions in regards to the type, frequency, and content of training in addition to which miners should receive the training. A requirement that all miners who work with, around, or near such a proximity system be trained on its function, maintenance and operation will support its proper use and effectiveness. MHSA should, within the training specifications, develop two levels of training for those miners who use or are affected by the system and those who are assigned to maintain the systems. This mimics similar industry standards such as the OSHA 1910.179 Crane standard (OSHA.gov)

Incorporation of a written examination (developed and validated), will test knowledge and skills identified as necessary for the safe operation of a proximity system (operator specific

training). A practical hands on portion of the testing must also be included. The following basic criteria derived from the OSHA Crane standard for operators for training curriculum and are recommended content for these proximity systems:

- Operational characteristics and controls, including characteristic and performance questions appropriate to the proximity system type for which qualification is sought;
- Emergency control procedures and or bypass restrictions shall be understood and the authorized person for who is allowed to bypass (with specialized training) shall be identified with in the training program and communicated all mine workers.
- Demonstrate knowledge of the manufacturers specific requirements
- Pass a practical hands on examination to demonstrate comprehension of how the system works and how to maintain the wearable sensor.
- Training shall be provided by a competent person. The definition of competent needs to follow the MHSA requirements for competency.
- Those who have not been trained on the new equipment shall not work with, around, or utilize the proximity system. In the case of new employees training shall be provided to the mine worker prior to entering the mine space.
- A verbal exam is allowed if following the same criteria as the written test.

The second type of suggested training to be required is for mine maintenance personnel (or equivalent) responsible for implementing and maintaining the proximity detection systems. In addition to understanding the operator training content above, maintenance personnel must understand and be able to verify competency through a written and practical exam procedure incorporating the following additional content:

- Proximity detection system terminology and applicable consensus standards
- Lockout/Block out and bypassing the proximity detection system (maintaining secured access to system configurations)
- Proximity system maintenance/repair guidelines
- Tools and their use
- Inspection and validation forms and requirements
- Overview of Federal Regulations
- Factors affecting system capabilities
- Calibration and System Set up requirements
- Daily, Monthly, Annual inspection criteria
- Documentation of system maintenance records
- System verification and validation methods (Buy-off procedures)*

Maintenance personnel (or equivalent) should complete refresher type training on an annual basis or when new system technology is introduced or integrated into mobile mining equipment. Also, within the maintenance specific training program, MHSA must include a system verification and validation methodology requirement to be used when a mining organization is integrating a new system or making system changes or upgrades (indicated by "*" in the above list). This will allow the mine maintenance personnel to verify and document the functionality of the system, once installed, for proper object detection and effective stopping or shut down of mobile equipment. A documented validation and verification procedure is integrated into many consensus standard requirements for automated equipment and safety devices which initiate stops; this is can be integrated in the MSHA standard and proposed ruling.

**Enforcement of the Proposed Ruling**

MSHA has not requested commentary on its overriding responsibility or its ability to enforce agency policy and requirements associated with implementing a new standard. The issue of capability and capacity of an agency to perform its desire function need to be taken into account when implementing a new standard or ruling. For MHSA agencies to be successful in making sure these systems are both effective and functional, MSHA should implement internal technical training with all inspectors so that they understand the technology and how it works, are able to identify if the proximity detection is operating correctly, and determine if the system is also configured and set up correctly. Understanding any new regulation is clearly a learned task, while first hand technical verification and validation of system is a skill that must be practiced. I personally request that agency inspectors work collaboratively with proximity detection manufacturers on an internal training curriculum for the agency itself. As new technologies are

incorporated into all aspects of safety and equipment federal agencies who implement our laws and regulations must become experts themselves in the ever advancing world of technology.

In summary, when issuing rulings which are much more than administrative and clearly result in the protection of human life, MSHA must take an assertive position and not limit its implementation of a beneficial technology to a small sector of the mining industry, especially when it has been proven to save lives in such a high risk environment. Economic benefit should be calculated to incorporate a wide spread and sweeping implementation within the proposed ruling documentation. With the incorporation of the above listed recommendations for improving an already effective ruling, the federal agency should approve and implement this new standard.

Works Cited

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