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Comment from Craig Ross, NA

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General Comment

See attached file(s)

Attachments

RFI - Safety Improvement technologies for mobile equipment at Surface mines

AB91-COMM-14

December 19, 2018

Comments regarding Safety Improvement technologies for mobile equipment at Surface mines, and for belt conveyors at surface and underground mines.

RIN 1219-AB91

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Introduction

Over the past two decades the mining industry has been successful in nearly eliminating fatalities in all categories with the exception mobile mining equipment. This can be attributed to 2 primary causal factors: Lack of visibility for heavy mining mobile equipment and fatigue management.

Personally, I have focused heavily in these two areas since 2009 by looking to technology help solve these two problems. Although recently retired from operations, I have continued my work with a technology company helping with product development to address the gaps that I have encountered while testing and trialing these technologies. I am comfortable commenting as follows regarding collision avoidance technology based on my experience and current commercial availability.

Lack of Visibility. The current practice requires miners to operate heavy machinery with the assumption that the area around their machine is clear. Operating with this assumption is primarily based on administrative controls i.e. operating/maintenance procedures. As we have all learned, administrative controls are the least effective mitigating controls and therefore we still have fatal accidents because a single mistake can lead to disaster. The key is how can we operate without having to "assume" the area is clear. Technology available today can accomplish this, but must meet some basic criteria to be effective:

1. Accurate without nuisance alarms (TRUSTED!)
    a. Configurable for operating conditions (i.e. Pit operations vs ready line vs shop)
2. Zero assumptions
    a. Who, what and where!
3. Capture ALL event data
    a. Who, what, where, when and type of unwanted event
4. Real time system health & remote reporting/configuration updates

<u>Accurate without nuisance alarms</u>

There are several available technologies on the market that can accurately detect people and machinery, however nuisance alarms have been a significant issue. There are two basic types of technology available to surface mines. 1) Peer to peer detection – which requires technology on each piece of equipment and person that is to be detected. 2) Radar – detects any obstacle within the detection zone without requiring the target object to be fitted with technology. I have learned through testing and trialing that both technologies are required to achieve success. But both technologies must be highly configurable to allow operating in the complex mining environment to eliminate nuisance alarms.

Peer to peer technology must incorporate GPS to be effective. GPS allows the technology to determine path and speed of vehicles in the area. This is critical to eliminate the nuisance alarms. Without knowing the travel path and speed, we can only determine proximity and an alarm event will occur even when there was no danger of collision (nuisance alarms). For example; two haul truck passing each other traveling in opposite directions scenario would always generate an alarm. But with use of GPS the zone of detection can be configured to only alarm if the vehicles were on a collision or near collision course. Another example; A haul truck and light vehicle are entering an intersection scenario. The light vehicle slows and stops at the intersection as the haul truck passes by in front of the light vehicle which has come to a stop. This scenario would generate a false alarm when using simple proximity detection. With GPS and smart technology, the system can determine that the light vehicle has slowed and is no longer in danger of intersecting the haul truck's path and no alarm would occur. However, if the light vehicle was not slowing or stopped, the system would alarm for both operators. With this type of technology operators can maintain situational awareness, i.e. know the location of other vehicles or people within their operating area and in addition, receive an alarm when there is a clear threat of collision without nuisance alarms.

Use of GPS also allow for geofencing and markers for desired stationary objects. A geofenced area can alarm when unauthorized vehicles enter the area or allow for a different configuration within the geofenced area. For example, during a snow storm all normal travel road may not be cleared for safe travel. In this case, temporary "no go" zones can be created to alarm operators should they approach these areas until it is safe for travel. Permanent structures such as powerline can be marked by geofencing and configured to alarm the operator if they approach the powerline with bed raised. The geofence areas can be permanent settings or temporary and configured to meet criteria for that area and controlled from a single location such as dispatch.

Radar technology is also required in addition to peer to peers with GPS. It is not feasible to place technology on every potential obstacle the heavy equipment operator may encounter. In slow moving situations such at maintenance area or parking area there is need for detection of any abject in front or rear of machine and radar that can be configured for the conditions is required. Radar is effective for slow moving operations and can be configured to shut off at higher speeds.

Personnel detection is a key necessary component for an effective system. The person wears a small tag that will provide visual alert to person when in near proximity of a machine fitted with technology. The device will provide audible, visual and vibration alarm when in unsafe zone. The device, similar to vehicle alert uses smart technology to only alarm when danger is imminent therefore reducing nuisance alarms. For example, a person wearing the device could be standing directly in front of haul truck and not receive an alarm if truck is secure with parking brake set. The system can be configured to alarm when parking brake is released or machine is put into gear. Both operator and ground person would receive alarm. The operator of the equipment would also wear a device that would only alarm when outside of the cab. The device also can be configured to alarm for operator if they exit the cab but forgot to set parking brake. This prevents exiting machine without securing machine by setting parking brake.

Over the past 9 years that I have been involved in testing and trialing these technologies. I believe only in the past two years at least one of these technologies are now capable of being utilized to prevent collisions while being trusted to provide accurate alarms without generating false nuisance alarms.

There are two primary reasons the mining industry has not implemented collision awareness technology, cost and nuisance alarms (expensive and not trusted to work effectively). The cost is still an issue for most companies, however I believe today even at the current costs purchasing the technology that meets the criteria outlined in this document is warranted and will save lives.

The high cost issue is based on technology configurability to be effective. To develop the technology to meet customer requirements has required extensive research and development by technology providers. The cost per unit and software takes into account these development cost and continuing R&D to continue to next step which is vehicle intervention systems (VIS). VIS takes the technology to next required level which is to interact with machine should the operator not take necessary intervening steps during an alarm event. VIS is currently available but on a limited basis. The reason for limited application at this time, is the requirement for the technology provider to work directly with mobile equipment OEM to enable application of brakes, retarder or other desired interventions. This must be done for each different model and type of machine. Although it can be done and is currently deployed on some machines, the time involved for each machine's deployment is resulting in limited deployment at this time. This could progress quicker if mine operators were to purchase current technology for collision awareness (situational awareness and alarms of for potential collision events), which would provide technology providers needed funding to further develop VIS which is next logical step towards autonomous operations.

The other cost issue is the need to deploy the technology on ALL mobile equipment and ALL personnel who may enter the mining operations area. This includes contractors and delivery personnel. A mining operation of 20 haul trucks may need as many as 300 units to be purchased and installed to ensure all other vehicles are equipped and numerous personnel detection tags. No vehicle or person should be allowed in the mining area without the technology for the system to be effective. This can be cost prohibitive by some operators as each vehicle unit may be thousands of dollars. For example, a basic unit for a light vehicle may be a few thousand dollars and a more complex unit for a haul truck may be much higher cost. A medium sized mine could expect to spend well over a million dollars in hardware/software to install an effective collision awareness system which includes all exposed vehicles and personnel.

There also is another issue with regards to deployment. A typical installation as noted above can take as much as a year to deploy. Each haul truck for example make take one or two days to install and then we still have installs for all the support equipment. A system must also be in place for quick mount units for contractors and delivery personnel. The quick mount peer to peer units that meet criteria noted above are currently available. In addition, all personnel must receive initial and refresher training on the technology.

I have also witnessed and another dilemma associated with the long duration to install and deploy the technology. Operations to date who have executed deployment at high cost, have done so after an extreme emotional event (fatal or near fatal accident). The emotions that helped drive the purchase have lessened by the time the installations are complete and system is ready go live. This opens the door of questioning cost vs benefit. If technology is not deployed correctly through sound management of change techniques, the chances of successful utilization are diminished as there are ongoing cost associated with maintenance agreements and software licensing.

One final note regarding ongoing success of system deployment; A system that meets criteria noted here will require management oversite to track and respond to alarms for unwanted events to make changes to operations to eliminate these events (any alarm is an indicator of an unwanted event i.e. near miss). I will discuss this further in my comments for collecting data.

Zero assumptions

Currently we ask heavy equipment operators to assume the travel path (forward or reverse) is clear. As we all know, there are significant blind spots associated with heavy mining equipment. My vision is that the mining industry and MSHA take on the position we should never again ask an operator to make such an assumption. Technology available today can achieve this vision.

As noted in criteria, I have learned through trial and testing that for the technology to be truly effective, the operator must always know who/what is in their working area and where they are located in reference to their equipment. This creates situational awareness and eliminates assumptions. If an unwanted event occurs where another person or piece of equipment is unsafe zone (too close or in travel path) the system will alarm. At this point the operator with the right technology will know who, what and where the threat is and can take the correct intervening action.

I am aware of several less expensive technologies that may only alarm but not provide exact location or indicate type of threat. This will still lead to assumptions regarding the threat and increase likelihood to incorrect assumptions and or actions.

The technology is commercially available to provide a scope view similar to that used in commercial aircraft. The operator can view a screen in their cab that shows all equipment and personnel in their working area. The technology I reference here is associated with the peer to peer and GPS technology noted above. It is very reliable and accurate.

Utilization of this type of technology can and will achieve situational awareness and alarm the operator of potential real threat of collision eliminating the current practice of operating with an assumption the area is clear.

Capture ALL event data (Who, what, where, when and type of unwanted event)

To truly eliminate accidents associated with mobile equipment, the root causes of such incidents must be addressed. Utilizing the type of technology, I reference in these comments can and will increase situational awareness and prevent collisions. However, whenever there is an alarm (unwanted event of potential collision) the causal factors that led to this event must be addressed. I.e. every alarm from a trusted system (no nuisance alarms) must be treated as a near miss.

The technology I am referencing is capable of capturing all data related to who, what, where, when and type of unwanted event. In addition, the technology can replay the event onto a map or satellite view for investigative purposes. Another capability of this technology is it can capture all event data and be displayed onto a heat map. The heat map is extremely beneficial as clusters of events can be captured

indicating a problem intersection or a procedural problem in parking que for example. This data can be sent to dispatch and monitored in real time or referenced and evaluated on a daily, weekly, monthly or annual basis to track performance. Events can also be filtered on the heat map to review specific types of events (light vehicle vs haul truck or following to close for example).

The capture and use of this data can result in a significant step change in safe performance at mining operations. Without the use of technology to inform management of potential collision events, we are often not aware there is a problem until a significant event occurs.

All mining operations have traffic management plans that contain multiple administrative controls to prevent unwanted interaction between equipment and personnel in the mine. The ability to capture and review the data noted here enable's management to monitor the effectiveness of these controls in real time and take necessary mitigating actions to improve overall safe performance.

One important note regarding data capture and analysis is that resources will be required to review and take appropriate actions. Management may have a tendency to install the technology but not be prepared to review and act on the data. Some may think all that is necessary is to install the technology and no other action is required. This approach will result in not achieving the desired performance in the long run. I think it is critical that management understand and are committed to reviewing and utilizing the data to improve performance. This will require addition resources and action if the technology is to achieve desired success. Deploying the technology must not be viewed as a one-time fix, but as an ongoing continuous improvement process.

Real time system health & remote reporting/configuration updates

The final necessary criteria for effectiveness of this technology is the ability to self-diagnose the system health in real time and to be remotely updated and configured from an external location. Older systems required updates in the field on every single unit. Today, this is not the case based on the technology I reference in these comments. Remote configuration and software updates can be performed from an any location at the mine or even offsite.

Since the technology is designed to prevent a fatal accident, it is critical that all units in the field are operating as designed at all times. Therefore, the system must be constantly self-diagnosing proper performance. The system must inform not only the operator but management that there is a problem with the system or a component so that mitigating actions can take place immediately. The technology I reference for the basis of my comments has this capability.

It should be noted that taking the position that technology is a safety critical device will be resisted until management feels the system can be trusted and is highly reliable. My experience indicates the technology I reference meets these criteria today. I would not have been comfortable making such a statement 3 years ago.

MSHA should be aware that an inspector's initial view of technology if installed is a safety device is a significant one in the mining industry. Management will be reluctant to deploy the technology should MSHA prematurely consider the installation of such technology as a safety device subject to regulatory enforcement. Over time, I believe management will not have this issue once the technology has been deployed long enough to gain the trust by management and operators that system is reliable and effective.

Final notes regarding my collision avoidance technology comments

As noted earlier, I have spent several years researching and trialing technology to resolve the problem of mobile mining equipment collisions. Based on this knowledge I have also worked directly with a technology provider to help with product development to meet the criteria needed to meet operational needs and eliminate nuisance alarms. My comments reference the best technology that I am aware of at this time which is available from Hexagon Mining. I suggest that MSHA request NIOSH to obtain additional detailed information directly from Hexagon to evaluate the current capabilities as I have noted in these comments.

I am comfortable in stating that at this time, the technology is ready and will meet the criteria as I have laid out in this document. We are the point, were we can take mitigating actions and never ask our operators again to "assume" the area is clear before operating their equipment.

Thank you

Craig Ross

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