To Whom It May Concern

I work for a company named Sasol Mining in South Africa. Our company has always strived for a zero harm strategy.

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We have learnt over the years that behaviour is the most critical aspect when it comes to safety, but that Engineering barriers are sometimes required when the behaviour of everyone, whether due to a lack of training or taking short cuts, cannot be relied on.

We decided to evaluate the global market in 2007 to establish if there are possible systems on the market that could aid us in reducing the number of harm incidents around mobile machinery. At that stage it was also indicated to us by numerous critics and OEM's that we won't find a solution to this problem as the technologies are not yet fully developed. Sasol, as a leader in our industry did however decide to try and find solutions, even if it meant that we had to assist with development of "useable technologies".

After a thorough evaluation and visits to different countries globally, we decided to run a trial with the Frederick Mining Controls (previously Geosteering) system. FMC had to make numerous changes to their product to suit our market as South Africa is looking for a system that can work on all mobile machinery and not only Continuous Miners as was the case in the USA at that stage.

After a successful demonstration by FMC, Sasol made funds available to roll the system out to all our inbound machinery including Continuous Miners, Shuttle Cars, Feeder Breakers, Roof Bolters and Load Haul Dumpers. The roll out is currently in progress and runs over a couple of years due to the size of this project. The FMC system proved to be very reliable and we only had losses in production for the first 8 hours of system activation as our people had to change their habits of working around machines. It is however important for us that the system is not seen as a barrier as it would make everyone complacent and increase the risk if there is a system failure for some reason.

As a Senior Engineer at Sasol Mining, I was responsible for the evaluation, trial and roll-out of this system. Based on this history, I'll answer the questions for you. This is however my findings and the way I experienced it.

1. Please provide information on the most effective protection to miners that you believe proximity detection systems could provide, e.g., warning, stopping the equipment, or other protection. Include your rationale.

I believe that the slow down (for fast moving machines) and the stoppage of moveable components of the machines is probably the only option as we found that warning an operator or person does not prevent an injury as they become used to the warnings over a period of time.

2. Other than electromagnetic field based systems, please address other methods for effectively achieving MSHA's goal for reducing pinning, crushing, and striking hazards in underground mines.

There are numerous technologies available on the market and one can probably not exclude them as a whole. What I found during the evaluation however is that EM is probably the most accurate system and the change in field size around steel, coal, etc is negligent. For the typical board and pillar mining it is important that the system used must be able to penetrate the coal to eliminate blind spots around pillars.

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3. In general, reliability is defined as the ability of a system to perform when needed. Please provide information on how to determine the reliability of a proximity detection system. The Agency would appreciate information that describes reliability testing, how reliability is measured, and supporting data.

There are two areas of concern; The first is the reliability of the system as mentioned in this question. We found that the Frederick Mining System in this regard proved to be very good as we probably did not have a single reliability problem in the past 18 months or so. The second part is the availability that is of importance to us. We measured this by looking at downtime reports and by having representatives of the system in the section where the installation took place. The purpose of this "commissioning team" is to ensure that the correct fault is identified during the early stages of the project. There is always a tendency to blame the "latest modifications" for the down time and these needs to be filtered out. We found that for the Frederick Mining system we had a good availability of around 99%. Both the factors are however very important to us as reliability problems increases our risk and availability problems causes frustration and production loss.

4. Manufacturers should design their systems to be fail-safe. Please provide information on how miners would know when a proximity detection system is not working properly. Include suggestions for what works best, including your experience, if applicable.

This is probably one of the most important factors to consider during the design phase of these systems. Sasol decided that a machine will stand if the system is not working and in our case everything is wired as fail safe. The manufacturer of the Proximity System must however have good diagnostics in place to guide the operator to the fault and reduce downtime caused by fault finding. We found that the diagnostics used by FMC is very good and we were able to find 99% of all faults (mostly equipment damage caused by roof falls) within a matter of minutes. It is also important that a temporary bypass facility must be made available as a machine could fail in "deep cut" where there is no roof support. In these cases the operator must be able to pull the machine back to safety.

5. Please describe procedures that might be appropriate for testing and evaluating whether a proximity detection system is functioning properly. Include details such as the frequency of tests and the qualifications of persons performing tests; include specific rationale for your suggestions.

There are a number of critical tests that should be done at regular interval. It is however important that the maintenance of the Proximity System must fall in with the machine maintenance and not cause additional standing time. We do weekly checks on components and monthly inspections on flameproof equipment to ensure that we pick up possible friction or damage and perform reliability centred maintenance. Critical checks that could however be performed on a weekly basis by a trained person are zone size checks, system communication checks and warning checks. These tests cover the basic functionality of the system. It takes about 15min to perform on each machine. The data gathered is then signed off by the person doing the checks and filed for reference.

6. Some proximity detection systems provide a warning before the equipment shuts down. An excessive number of warnings can cause miners to become complacent and routinely ignore them as nuisance alarms. Please describe any experience you have had with nuisance alarms and how you addressed these alarms to assure an appropriate level of safety for miners. In addition, please provide suggestions for minimizing nuisance alarms.

My opinion is that there should not be any nuisance alarms allowed on these systems. The system should only warn an operator if he is at risk and there is a possibility of him stopping the

machine. This was one of the required changes we had for the FMC system. Currently the system only warns a person when he enters this warning zone (about 2-3 feet from the stop zone). If he stays within this zone as the case may be with a continuous miner operator, he will not be warned again. This proved to be working very well for us and we did not pick up any levels of frustration. We also use this zone to slow our Shuttle Cars down and this worked out great as the Shuttle Car now slows down when passing the Continuous Miner Operator and prevent hard impacts between these two vehicles due to high speed approach during the loading process. It also flags to the Continuous Miner Operator that a Shuttle Car is coming in (possibly from behind) and he needs to move over.

7. How should the size and shape of the area around equipment that a proximity detection system monitors be determined? What specific criteria should be used to identify this area, e.g., width of entry, seam height, section type, size of equipment, procedures for moving equipment, speed of equipment, and related information? Please provide any additional criteria that you believe would be useful in identifying the area to be protected.

We used statutory maximum breaking distance and equipment "reach" as a starting point to establish zone sizes. The idea is to keep the zones as small as possible without risking that a machine will not be able to come to a stand still. We then take the next step to determine generator positions in the critical areas to wrap the machine in as constant zone as possible from all angles. This does not mean that you require 10 generators for an even field, but rather that you ensure that the front and rear zones of a shuttle car are as close a match as possible to prevent confusion. Once this is done, we start looking at the operation of a vehicle and try to establish if the zones we decided on will not hamper the production methodology of our company. If we need to make changes at this stage, we do a proper risk assessment as our first priority is the safety of people.

8. Proximity detection systems can be programmed and installed to provide different zones of protection depending on equipment function. For example, a proximity detection system could monitor a larger area around the RCCM when it is being moved and a smaller area when the machine operator is performing a specific task, such as cutting and loading material. How should a proximity detection system be programmed and installed for each equipment function?

We only used a fixed zone size to prevent confusion although it might be worth looking into this.

9. Since 1983, six fatalities occurred while miners performed maintenance on RCCMs. The fatalities involved three miners crushed in the machine and three miners pinned between the machine and mine wall or roof. Please provide specific information, including experience, on how a proximity detection system might be used to protect miners during maintenance activities and why the system would be effective in each situation.

This is a tricky question! The FMC system we're using is designed to protect people when the machine is ready to operate. In most cases we look at the "Pump On" indication as the majority of machines can only operate after the main pump was started. If the pump is not on, normal maintenance can take place without any risk as the machine cannot move. Once the pump is started however, everyone needs to stay away. This is not always possible as live testing needs to take place sometimes. For this, we have a "Live Testing Permit" where the legally appointed person gives permission that people may work in the proximity of a piece of equipment. Additional risk assessments must be done and very specific procedures followed in this case as the system will be bypassed. We found that it is important that these procedures must be in place and everyone properly trained on them before a system is installed in a production section.

10. Some proximity detection systems include an override function that allows the system to be temporarily deactivated. Please provide information on whether an override function is appropriate and, if so, please provide information on the circumstances under which such a function should be used. Please provide information on the types of procedures or safety precautions that could be used to prevent unauthorized deactivation of a proximity detection system.

We currently have a bypass function to pull a machine to safety for component replacement or fault finding. This bypass should however not deactivate the system, but rather the specific failed component(s) as the remaining components could still protect the person in proximity. Normally a roof fall takes place in the front part of a continuous miner and might damage the two generators in front. When pulling the machine back to safety after a bypass, the rear generators are the critical ones and should still be used. This bypass should also have an automatic deactivation after a certain time delay. The bypass described in question 9 is by means of physically opening panels and deactivating the proximity relays. It is not a "quick fix" and we can pick this up in the data gathered from the machine. We then know who did the bypass, at what time and can then check if his permit to do so was in place. As I always say...you need to close the loop!

11. MSHA found, in its field testing experience, that the use of some new technology for controlling motor speed, like variable frequency drives, could result in nuisance or false alarms (shutdowns) from the proximity detection system. Please provide information on other sources of interference, if any, that might affect the successful performance of proximity detection systems in underground mines. In addition, please provide information on whether a proximity detection system might adversely affect other electronic devices, such as atmospheric monitoring systems, used in underground mines. Please provide specific circumstances including: (1) Types of equipment; (2) adverse effect; and (3) how the adverse effect could be minimized.

We're using just about every type of machine including VSD driven. We found that the machine system never shuts down as a result of these systems, but it is possible to get a false indication at your personal warning device if you are within 1/2 foot of the supply cable to the VSD. We found this not to be a problem with the FMC system as our people are not supposed to be in that close contact of the cables. If it does become a problem, it can be resolved by swopping position of his rescue pack and cap lamp on his belt.

12. Commenters who have experience with RCCMs, please describe: (1) any experience with pinning, crushing, and striking hazards, including accidents and near misses; and (2) any unique experience with an RCCM with auxiliary equipment attached.

We equip the entire fleet of machinery in a production section and not only the Continuous Miner. This is thus not a problem for us.

13. How should the area that a proximity detection system monitors be determined on an RCCM interconnected with auxiliary equipment?

A stand-alone Continuous Miner is not a problem and should have the zones as discussed earlier. Ones we start making use of Continuous Haulage, it changes as all the access points and operator Stations should be monitored. In principal, a person may not be allowed to walk between the conveyor and the coal pillars if the system or machine is operational. It does not help just locking off a specific piece of the chain as the remaining parts can still move that part on an action-reaction basis.

14. Describe whether there are safety benefits from applying proximity detection systems to underground equipment other than RCCMs. Describe your experience with pinning, crushing, or striking accidents and near-misses involving other underground equipment. Please provide examples identifying the specific types of equipment involved and how proximity detection systems may help provide an additional margin of safety to miners. Also describe any experience you have with respect to obtaining MSHA or other agency approval for systems designed for underground equipment other than RCCMS.

As mentioned, we install the system on all in-section production machines. There are however changes to the system depending on the machine type. In South Africa we follow the normal approval procedure where the equipment is tested and inspected by a certified body for use underground in coal mines. It does always help to work on the 80-20 principle if funding is a problem. We had injuries on most of our machines and it would be wrong to say that an injury on a Shuttle Car is from example more acceptable than an injury on a Continuous Miner.

15. How might a proximity detection system for remote controlled equipment be different than one for non-remote controlled equipment?

In principal it must be exactly the same. The only difference is that FMC had to make provision for on-board operators by the creation of safe zones in the cabs.

16. Manufacturers are evaluating the use of proximity detection systems on multiple pieces of equipment that operate near each other, such as RCCMs and shuttle cars. In your experience, what are the safety considerations of coordinating proximity detection systems between various types of underground equipment?

I had to work with different OEM's to address this and it is not an easy task as every OEM has his own idea of how it should operate. I believe that it will not add a lot of value if every manufacturer has his own Proximity System as the people working underground will not have enough space on his belt for example to fit all these devices. It would in my opinion add a lot more value if the OEM's certifies certain systems as acceptable and rather concentrate on the interface and interlocks between the Proximity Systems and the machine.

17. Describe your experience with the state-of-the-art of proximity warning technology. Include any experience related to whether the current technology is able to accurately locate and protect workers from all recognized hazards.

As I explained previously I can only speak for the Frederick Mining System and the system is performing beyond expectations. It should not be left out that we did experience some teething problems, but with dedication from the supplier and management commitment from our side, these problems were addressed in a very short time. The system is running on our mines and as they say...the proof is in the pudding!

18. What knowledge or skills would be necessary for miners to safely operate equipment that uses a proximity detection system? What knowledge or skills would other miners working near the equipment need?

Training is part of our management of change process and forms a vital part in the success of these systems. Frederick Mining currently provides training for our operators, maintenance personnel, lamp room operators, management (awareness), trainers and installation teams. None of these in my opinion can be left out.

19. Please provide suggestions on how to effectively train miners on the use and

dangers of equipment that uses a proximity detection system. Please include information on the type of training (e.g., task training) that could be used and on any evaluations conducted on the effectiveness of outreach and/or training in the area of proximity detection (e.g., red zone warning materials). How often should miners receive such training?

We train our people in a classroom setup as a start. Once we activate the system (without interlocks active), we train them in the work environment by indicating that they would've stopped a machine now and should take one step back, etc. We also do regular audits and evaluate the data we receive from the system. This data provides us with accurate information of the number of near misses around the various machines. From the data we can also look at specific job types, machine types, a specific person or a team to enable us to evaluate if the problem does not lie with our method of operation. We have annual refresher training, but it is not important for us to concentrate on the dangers of machines with these devices as we opt to spent time on the dangers of all machines and it is still their own responsibility to stay away from mobile machines. The system just assists us if a person accidentally does something wrong.

20. Please provide information on the benefits of using proximity detection systems with RCCMs. Please be specific in your response and, if appropriate, include the benefits of using proximity detection systems with other types of underground equipment. Include information on your experience related to whether proximity detection systems cause a change in the behavior of an RCCM operator. For example, would the operator need to operate the machine from a different location, such as one that might introduce additional hazards, to remain outside of a predefined danger zone? Please explain your answer in detail and provide examples as appropriate.

The Proximity System has a lot more benefits than risks, but it is important to do everything in conjunction with a risk assessment. An example of this is that we used a third zone (second warning) on the Frederick Mining system for Shuttle Cars to enable us to slow the machine down adequately before stopping the machine. This is important as there could be a major risk of injury to the operator if the breaking is too sudden and unexpected. There is also a risk for roof bolt operators who are suspended high above the ground (we're mining seams up to 18 feet) when the movement functions stop. It once again brings attention to the importance of identifying these risks and putting proper procedures in place to eliminate risk introduced by the system.

21. Please provide information on the costs for installing, maintaining, and calibrating proximity detection systems on underground equipment. What are the feasibility issues, if any, related to retrofitting certain types of equipment with proximity detection systems?

Due to competition law regulations in South Africa we are not allowed to go into the details of the cost. What I can say is that the running cost per annum of these systems are probably around 5% of the capital cost depending on the mining conditions and protection of the devices. We maintain these units ourselves.

22. What is the expected useful life of a proximity detection system? Please provide suggested criteria for servicing or replacing proximity detection systems, including rationale for your suggestions.

We indicated that we expect a life of around 10 years which is very long for electronic equipment. The systems are currently running for about a year and a half and I cannot yet comment accurately on this.

23. Some proximity detection systems automatically record (data logging) information about the system and the equipment. Are there safety benefits to having a proximity detection system automatically record certain information? If so, please provide specific details on: (1) Safety benefits to be derived; (2) information that should be recorded; and (3) how information should be kept.

The information required will be depended on the client to some extend. We found that the most important data is the voltage of the cap lamp (system is integrated into the cap lamp), the specific tag / person, the time of the start and end of the event, the machine involved, the action taken and the status of the buttons. This information could then be converted and filtered into any possible format or requirement and we use it for training and if training does not help, we take a step further into disciplinary action.

24. Please provide information on whether small mines or mines with special mining conditions, such as low seam or mine entry height, have particular needs related to the use of proximity detection systems. Please be specific and include information on possible alternatives.

Our mines vary from about 6 - 18 feet seems and we do not have very low seems. I do however believe that the principle should stay the same and that the same technology should be used. The focus should be on the horizontal protection with added vertical coverage if required. I do not believe that small mines have a lower risk than the larger mines.

25. What factors (e.g., cost, nuisance alarms) have impeded the mining industry from voluntarily installing proximity detection systems on mining equipment?

I believe that it is normally easy for us to say that the system is not working as there is money involved which influences our profits. I do however not believe that this can be used as an excuse anymore as we proved that at least one system is working very well. We found however that it takes a bit of effort from the management at the beginning to ensure that the system runs properly. Once the system is embedded, the people will start taking ownership of it and will not operate a machine without such a system as it is unsafe.

I hope this answers most of your questions. Please feel free to contact me should you have specific questions.

Regards,

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