Collision Avoidance Systems and Solutions

TerreSauver, Collision avoidance solution (CAS) specialists

Background

"Quarries and mines (surface and especially underground) are two of the most dangerous workplaces in the world. More people are killed or injured in the mining industry than any other. Globally, official statistics show that 15 000 miners are killed each year, although the real figure is likely to be many more."
Global mining review; 9 July 2020

The second largest contributor to these statistics is mining vehicle collisions – vehicle-to-vehicle, vehicle-to-person and vehicle-to-infrastructure collisions.

Based on the ICMM (International Council on Mining & Metals) Benchmarking Safety Data statistics, the ICMM and leading suppliers have announced a plan to make mining vehicles cleaner and safer at the International Mining and Resources Conference (IMARC) in Melbourne, Australia.

The cleaner, safer vehicle initiative aims to:

- Minimise the operational impact of diesel exhaust (e.g. electric vehicles) by 2025
- **Make collision avoidance technology available to mining companies by 2025.**

South Africa taking the lead

GOVERNMENT GAZETTE, **27 FEBRUARY 2015**; DEPARTMENT OF MINERAL RESOURCES (No. R. 125); MINE HEALTH AND SAFETY ACT, 1996 (ACT NO 29 OF 1996) - REGULATIONS RELATING TO MACHINERY AND EQUIPMENT; Amendment of Chapter 8 of the regulations:

8.10.1: The employer must take reasonably practicable measures to ensure that pedestrians are prevented from being injured as a result of collisions between trackless mobile machines and pedestrians. At any mine where there is a **significant risk** of such collisions, such measures must include at least the following:

- ***Is the mining industry ready for implementing CAS level 9?***
- ***Are the CAS technology providers and the CAS technology ready and stress tested for reliability?***
- ***Are the OEM's (mining vehicles) respective technologies ready for a reliable CAS level 9 implementation?***
- ***What is the RISK impact by implementing CAS level 9?***

- All **electrically or battery-powered** trackless mobile machines, upon detecting the presence of a pedestrian, must be able to automatically detect, warn, retard (crawl) and stop without human intervention
- **All <u>underground</u> diesel-powered** trackless mobile machines must be provided with the means to automatically detect, warn (operator and pedestrian), retard (crawl) and stop without human intervention
  - The collision detection system on the diesel powered trackless mobile machine must fail to safe without human intervention
- **Every diesel-powered trackless mobile machine** must be provided with means to automatically detect the presence of any other diesel-powered trackless mobile machine within its vicinity, warn (both operators), retard (crawl) and stop without human intervention.
  - The prevent potential collision system on the diesel-powered trackless mobile machine must 'fail to safe' without human intervention.

The CAS level 9 risk assessment, user requirement specifications, technical specifications, detailed test procedure and acceptance requirements, have been developed by Alan Marneweck (chief engineer, TerreSauver) and his team.

Questions asked by the mining industry:

1. Is the new generation PDS, i.e. collision avoidance systems (CAS) level 9 (IMESRT) technology, ready for large-scale deployment in both surface and especially underground mines?
2. Are the various OEMs ready for CAS level 9 implementation – especially in terms of the older unintelligent vehicles?
3. Apart from compliance (beyond compliance), what is the benefit vs. the total order of magnitude costing of implementing CAS level 9?
4. What are the practical, technical and operational challenges in implementing CAS level 9 (lifecycle of the vehicles as well as brakes, drive train, and other wear systems)?
5. How does one align the traffic management plan (especially underground, where there are numerous legacy shafts with extensive traffic flow limitations) with the implementation of CAS level 9?
6. How does one implement large-scale CAS implementation without bringing the mine to a stand-still?
7. Which vehicles should be level 9-classified?
8. How do we align our traffic management plan, our risk assessment and the CAS level 9 requirements and implementation?

TerreSauver has just completed the largest and most comprehensive collision avoidance technology testing in surface and underground mines, of its kind in the world using actual production vehicles in an actual production area.

Most of the testing is pioneering work in the field of collision avoidance technology level 9 (as is required by the South African Mine Health and Safety Act set out above);

- testing the CAS technologies available vs. the user technical and operational collision avoidance requirements,
- ensuring it is a fit-for-purpose solution (including from a technical and operational point of view).
- The tests have been developed are being led by ***Alan Marneweck (chief engineer, TerreSauver)***.

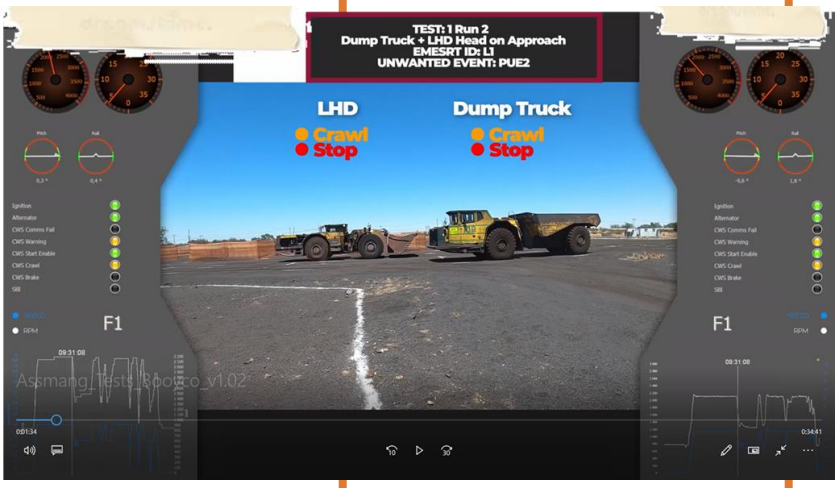
Complexity of the current test environment:

- Above and below ground; vehicles moving between above and below ground; hard rock, bord and pillar mine
- Roads very undulated, uneven and full of twists and turns (unlike coal mines, for example)
- Various shafts – comprising of new development areas as well as legacy areas with extensive traffic flow challenges
- Large numbers of pedestrians and vehicles interacting (> 400 vehicles and > 5 000 underground workers, e.g. pedestrians)
- Mixed fleet, in terms of vehicle types, as well as multiple OEMs, diesel and electric as well as intelligent and unintelligent vehicles (which will need a CAS level 9/ ISO21815 compliance interface)
- Very high distrust amongst operators and pedestrians based on their current PDS technology experience
- Numerous questions to answer:
  - **The cost vs. benefit**
  - Regulatory compliance requirements vs. risk assessment, i.e. alignment of the traffic flow risk assessment and collision avoidance technology; which vehicles should be level 7/8 and which level 9 (as described in the above excerpt from the South African law)
  - Review and re-alignment of the traffic management plan with the collision avoidance technology
- How to optimise/benefit from the collision avoidance system's implementation to increase production, e.g. load and haul cycle times.

Testing

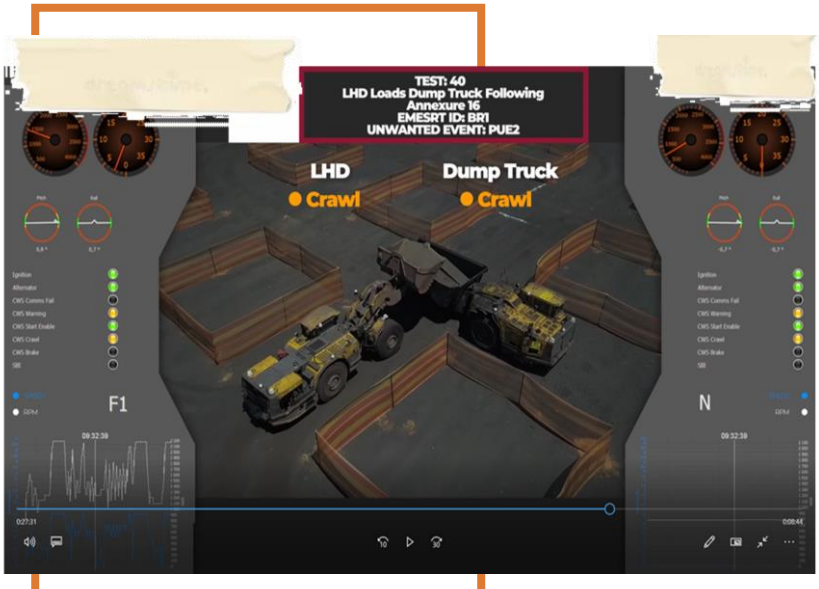
- Detailed user requirement specification has been developed across all stakeholder groups
- Detailed technical requirement specifications have been developed based on the above user requirement specifications, as well as the regulatory requirements
- Detailed test procedure has been developed in order to answer and confirm all of the above requirements
  - How mature and stable is the collision avoidance technology available?
  - How practical and doable are the various user and technical requirements?
  - What will be the impact on production and safety in the context of each requirement tested?
- Testing comprised of >60 operating scenarios (based on both the EMERST identified potential unwanted events, as well as the client's site-specific operating scenarios), in the actual operating environment with standard production vehicles (LHDs and dump trucks), utility SUVs and pedestrians. Each test has been repeated 3-4 times to test for consistency and repeatability.

Test rest results



We now have a comprehensive, detailed understanding of:

- How the collision avoidance technology actually works
- Its functionality and limitations
- How the OEM actually reacts to the collision avoidance technology crawl and stop (emergency brake) signals
- The required interface should you have older/unintelligent vehicles in your fleet
- Any interference from the collision avoidance technology with any other related already on-mine system, e.g. PetroMan system, underground radios, etc.
- The different collision avoidance technology suppliers, their unique capabilities (strengths) as well as what the limitations are of the various technologies
- The impact of the collision avoidance technology on the vehicle braking and different wear systems.



Installation, implementation and oversight

- Integration of:
  - Collision avoidance technology
  - Traffic management plan
  - Human element (acceptance and trust of the technology by all pedestrians, operators as well as shift bosses, foreman and miners, as well as acceptance and adherence to traffic management related regulations and operating procedures by operators and pedestrians)
- Capital application
- Detailed installation plan (with least impact to production) and switch-over process.

Contact

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