MINERALS COUNCIL
SOUTH AFRICA

INTERPRETATION OF THE TRACKLESS MOBILE MACHINERY (TMM) REGULATIONS TO GUIDE MINES' IMPLEMENTATION ACTIONS

1 BACKGROUND

The TMM regulations found in Chapter 8 of the Mine Health and Safety Act Regulations were promulgated on 27 February 2015 with the suspension of regulations 8.10.1.2(b) and 8.10.2.1(b), which required the automatic slow down and stop of diesel-powered TMM. The commencement date of the suspended clauses in the TMM Regulations was gazetted on 21 December 2022, which was also the effective date in Gazette No. 47790, Vol 690, Government Notice No. 2908 on which the regulations became enforceable. For context, this gazette must be read in conjunction with Government Gazette No. 38493 published on and dated 27 February 2015.

Prior to the lifting and since the publishing of the gazette, the Minerals Council has been inundated with frequently asked questions from various stakeholders. These questions are indicative of the need for proper interpretation of the regulatory requirements and definitions of terminology particularly reasonably practicable measures and significant risk of TMM collisions as contained in the TMM Regulations. Doing so will provide a solid foundation to guide understanding and subsequent implementation actions by mines, including but not limited to whether to install collision prevention systems or even to apply for exemption, etc.

This document seeks to facilitate such understanding by explaining the regulatory requirements in Chapter 8.10.1 and 8.10.2 from a practical and contextual perspective. Annexure 1 deals with definitions of terminology particularly "reasonably practicable" and "significant risk" of TMM collisions.

2 REGULATORY REQUIREMENTS FOR MINES

2.1 Actions for All Surface and Underground Mines

a) All employers (surface and underground) must take reasonably practicable measures to prevent vehicle to pedestrian collisions in which pedestrians may be injured and vehicle to vehicle collisions in which persons may be injured (i.e., effective traffic management, but no specific technology requirement yet).

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Regulation 8.10.1 (Extract)

"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:

Regulation 8.10.1.1 (Extract)

All electrically or battery powered trackless mobile machines, excluding shovels, bucket wheel excavators and overburden drills, must be provided with means to automatically detect the presence of any pedestrian within its vicinity. Upon detecting the presence of a pedestrian, the operator of the trackless mobile machine and the pedestrian must be warned of each other's presence by means of an effective warning. In the event where no action is taken to prevent potential collision, further means must be provided to retard the trackless mobile machine to a safe speed whereafter the brakes of the trackless mobile machine are automatically applied without human intervention."

b) All electrically or battery powered TMM (both surface and underground), which operate in areas where there is a significant risk of such collisions (that is, collisions in which pedestrians may be injured) already need, as a minimum (i.e., "at least"):

- Pedestrian detection means within TMM vicinity.
- Effective warning for both the operator and the pedestrian.
- Means to slow down to a safe speed and then automatic stopping.

2.2 Actions for Underground Mines

Regulation 8.10.1.2 must be read in conjunction with the last statement of Regulation 8.10.1: *"…at any underground mine where there is a significant risk of such collisions…"* (that is, collisions in which pedestrians may be injured):

- Diesel powered TMMs must have pedestrian detection means within the TMM's vicinity.
- An effective warning must be given to both the operator and the pedestrian.
- If no action is taken (e.g., pedestrian moves away or operator slows/steers), the TMM must automatically slow down and stop.
- The collision prevention system (CPS) on the TMM must fail-to-safe without human intervention. This means that when the CPS fails the TMM will become inoperable.

Regulation 8.10.1.2 (Extract)

"All underground diesel powered trackless mobile machines must be provided with means:

(a) to automatically detect the presence of any pedestrian within its vicinity. Upon detecting the presence of a pedestrian, the operator of the diesel powered trackless mobile machine and the pedestrian shall be warned of each other's presence by means of an effective warning; and

(b) in the event where no action is taken to prevent potential collision, further means shall be provided to retard the diesel powered trackless mobile machine to a safe speed whereafter the brakes of the diesel powered trackless mobile machine are automatically applied. The

prevent potential collision system on the diesel powered trackless mobile machine must fail to safe without human intervention."

2.3 Actions for Opencast or Open Pit Mines

All employers (surface and underground) must take reasonably practicable measures to prevent vehicle to vehicle collisions in which persons may be injured (i.e., effective traffic management, but no specific technology requirement yet).

Regulation 8.10.2 (Extract)
"The employer must take reasonably practicable measures to ensure that persons are prevented from being injured as a result of collisions between diesel powered trackless mobile machines…"
"…At any opencast or open pit mine where there is a significant risk of such collisions, such measures must include:

Regulation 8.10.2.1 (Extract)
"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; and

(a) upon detecting the presence of another diesel powered trackless mobile machine, the operators of both diesel-powered trackless mobile machines shall be warned of each other's presence by means of an effective warning; and

(b) in the event where no action is taken to prevent potential collision, further means shall be provided to retard the diesel powered trackless mobile machine to a safe speed where after the brakes of the diesel powered trackless mobile machine are automatically applied. The prevent potential collision system on the diesel powered trackless mobile machine must 'fail to safe' without human intervention."

At any opencast or open pit mine (the above portion excludes underground) where there is a significant risk of such collisions (collisions between diesel powered TMM in which persons may be injured):

- Diesel powered TMMs must have means to detect other diesel TMMs in their vicinity.
- Effective warning must be given to both TMM operators.
- If no action is taken (e.g., either operator slows/stops/steers to avoid colliding), the TMMs must automatically slow down and stop (practically not necessary for both – one can slow down and stop, the other can proceed).
- The CPS on the TMM must fail-to-safe without human intervention. This means that when the CPS fails the TMM will become inoperable.

3 REGULATORY SUMMARY AT A GLANCE

The table below provides a brief overview of the regulatory requirements at a glance based on details outlined under 2.1; 2.2; and 2.3 above.

TMM TYPE / INTERACTION	UNDERGROUND		SURFACE	
	ELECTRIC & BATTERY ELECTRIC	**DIESEL**	**ELECTRIC & BATTERY ELECTRIC**	**DIESEL**
Vehicle to pedestrian	• Reasonably practicable measures • Effective warning • Automatically Slow down & Stop	• Reasonably practicable measures • Effective warning • Automatically Slow down & Stop • Fail to safe	• Reasonably practicable measures • Effective warning • Automatically Slow down & Stop	• Reasonably practicable measures
TMM to TMM	Not mentioned	Reasonably practicable measures	Not mentioned	• Reasonably practicable measures • Effective warning • Automatically Slow down & Stop • Fail to safe

ANNEXURE 1 – DEFINING "REASONABLY PRACTICABLE" MEASURES AND "SIGNIFICANT RISK" OF TMM COLLISIONS

1 BACKGROUND

The TMM regulations found in Chapter 8.10 of the Mine Health and Safety Act Regulations are now all in full effect as per Gazette No. 47790, Vol 690, Government Notice No. 2908 published on 21 December 2022. The regulations make repeated mention of the words "reasonably practicable measures" and "significant risk". These regulations require a mine to introduce "reasonably practicable" measures to prevent persons from being injured because of TMM collisions. This introduces auto slow and stop technology where there remains "significant risk" of collisions.

It has been noted that there was wide uncertainty as to the context and application of these terms when the Chapter 8.10 TMM Regulations were first published and after the recent lifting of the suspension on Regulation 8.10.1.2(b) and 8.10.2.1(b). Following extensive engagements with multiple stakeholders, the Minerals Council seeks to use this document to highlight the industry's aligned interpretation of the above terms which is key for advocacy and compliance efforts.

2 DEFINITION OF TERMS: "REASONABLY PRACTICABLE" AND "SIGNIFICANT RISK" OF TMM COLLISION

2.1 Reasonably Practicable

Reasonably practicable is an internationally applied objective test to determine the obligation of a duty holder.

Section 102 of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) contains the definitions of words used in the Act, unless the context otherwise indicates. A general note prior to Chapter 1 of the Act states that "An italicised word or phrase indicates that the word or phrase is defined in section 102 of this Act". It must be noted that the term "reasonably practicable" is also contained therein and the following discussion will be in the context of the TMM regulations of Chapter 8.10 of the same Act.

Section 102 states that:

"**'reasonably practicable'** means practicable having regard to-

(a) the severity and scope of the *hazard* or *risk* concerned.

(b) the state of knowledge reasonably available concerning that *hazard* or *risk* and of any means of removing or mitigating that *hazard* or *risk*.

(c) the availability and suitability of means to remove or mitigate that *hazard* or *risk*; and

(d) the costs and the benefits of removing or mitigating that *hazard* or *risk*;"

In Chapter 8.10, employers are first required to take reasonably practicable measures to prevent persons from being injured because of collisions, be it machine to machine or machine to person. The use of technology, when required and as mentioned in Chapter 8.10, is secondary to these reasonably practicable measures and does not absolve a mine of its obligation to introduce reasonably practicable measures.

It is worth noting that, through its MOSH Transport and Machinery team, the Minerals Council has developed a set of measures that can be used to fulfil all the considerations mentioned in the above definition. These measures are packaged in the documents discussed below for use by mines.

2.1.1 MOSH Traffic Management Leading Practice for Open Pit/Cast Operations in South Africa

This MOSH Leading Practice for Open Pit/Cast mines deals exclusively with the safe movement of people and vehicles on surface operations. The MOSH Traffic Management Leading Practice consists of the establishment of an effective Traffic Management System, the maintenance and improvement thereof as well as assuring adherence (management) to all controls used as part of it. Surface mines are welcome to register to adopt this Leading Practice at MOSH Traffic Management Leading Practice for Open Pit/Cast Operations.

2.1.2 MOSH Traffic Management Technical Guide for Underground Trackless Operations in South Africa

The MOSH Traffic Management Technical Guide for Underground Trackless Operations seeks to assist mines to identify potential improvement to existing controls and operating procedures and in so doing, enhance existing measures to prevent traffic related accidents. This MOSH technical guide is a consolidation of leading practices from the industry into a single technical guide that may be adopted by underground trackless mines to assist in the management of traffic. This document may be downloaded at MOSH Traffic Management Technical Guide for Underground Trackless Operations.

2.1.3 Thungela Operations: Case Study for Applying MOSH Traffic Management Leading Practice

Statistical analysis by Thungela Operations of surface mines' TMM accidents over the past 12 years within the South African mining industry shows that as much as 80% of TMM accidents are because of undesired Traffic Management controls, driver behaviour and fatigue related incidents.

As a means of reducing this significant risk posed by TMM's in mining operations, Thungela Operations Limited (previously known as Anglo American Coal South Africa) adopted the Earth Moving Equipment Safety Round Table (EMESRT) Levels of Control model, through the MOSH Traffic Management Guideline as guidance for the

development of the Thungela Collision Management Strategy (CMS). This was a very successful Level 1-8 Implementation project that Thungela has embarked on and as elaborated in the attached presentation (Attachment 1 and Attachment 2).

The Thungela Collision Management Strategy (CMS) Consist of 3 Aspects:

- Organizational Structure
- Key Physical Implementations and
- Operator Support Technology Considerations (level 7-8)

It is believed that the Thungela Significant Risk Reduction & Elimination journey, with relation to TMM Incidents, and the methodology followed is an example of leading practice solutions in the industry.

2.2 Significant Risk

In terms of TMM regulations a mine is required to at least introduce auto slow and stop technology on its TMMs where there is “significant risk” of collisions.

The term “significant risk” appears 54 times in the current version of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996). The main challenge is that it is not defined in section 102 along with the other definitions used in the Act, making it open for wide interpretation. In the context of TMM collisions, the following applies:

2.2.1 SAMRASS and MHSA Definitions

The South African Mines Reportable Accidents Statistics System (SAMRASS) Codebook for Mines tried to define this term. The Codebook mentions that the term “significant” is defined in the Oxford Dictionary as being "noteworthy, of considerable amount or considerable effect or considerable importance".

The definition of the word “risk”, on the other hand, can be found in section 102 of the Mine Health and Safety Act (MHSA) and is defined as:

“**'risk'** means the likelihood that occupational injury or harm to persons will occur;”

The SAMRASS Codebook for Mines then finally makes the assertion that: “It is not possible to legislate the definition of ‘significant risk’, as this will invariably differ from mine to mine, commodity to commodity or even operation to operation. It is therefore the duty of every employer to conduct a risk assessment as required in terms of Section 11 of the MHSA to determine the significant risks to the safety of persons at that particular mine.”

2.2.2 Significant Risk of TMM Collision

Since it is not scientifically possible to predict the consequence of a potential TMM collision, industry stakeholders agree that the worst-case consequence of any vehicle to vehicle or vehicle to person collision is a single fatality or more, irrespective of the speed of vehicles as witnessed in historic accident data. So, in risk assessment language, this would mean that the "Consequence" will always reflect as "high" (i.e., significant, or noteworthy, of considerable amount or considerable effect or considerable importance). There is not much that a mine can do to change this reality.

It is further agreed that unless there are controls in place to prevent a collision, the "Likelihood" that injury or harm to persons may occur will also be "high" (i.e., significant, or noteworthy, of considerable amount or considerable effect or considerable importance).

Industry stakeholders have therefore concluded that if a mine seeks to prevent persons from being injured because of TMM collisions, it must prevent collisions by introducing "reasonably practicable" measures to reduce the "Likelihood" of TMM collisions. The use of the legally required technology should then be considered only as a last resort where the risk of such collisions remains significant even after the application of "reasonably practicable" measures.

2.2.3 Determining the risk in more quantified manner using digital twin tool

Risk assessments can be bolstered using a digital twin as a predictive tool that looks forward in time by modelling the historic data and predicting potential risk elements. The idea is to determine the risk in a more quantified manner. Essentially, it is about knowing the past and using that data to model the future using scientific, systematic, evidence-based, optimised, cost-effective and sustainable solutions tailored for mine-specific requirements. Focus is on the simulation platform for both surface and underground. This can model vehicles, vehicle movements, pedestrians' movements, geographic layouts, some processes, sensing, as well as traffic management rules. Typically, the outputs are heat map profiles where one could identify areas where potential interactions could occur. A digital twin pilot project is underway at Exxaro's Grootegeluk Colliery.

3 CONCLUSION

It is the view of the Minerals Council technical project team that proper interpretation of the regulatory requirements and definitions of terminology particularly "reasonably practicable" measures and "significant risk" of TMM collisions as contained in the TMM Regulations is necessary. Doing so will provide a solid foundation to guide understanding and subsequent implementation actions by mines, including but not limited to whether to install collision prevention systems or even to apply for exemption, etc.