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**Safety, Health, Environmental and Risk Consultancy Group**



## Risk Assessment Report

Aard Mining Equipment (Pty) Ltd

Scaler: 3 or 4 Wheeler



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**TITLE OF REPORT: Scalar: 3 or 4 Wheeler****Brief Description:**

A comprehensive evaluation to determine the hazards and risks involved with the operation, proper use, limitations and interactions to other machinery (mobile and stationary) with regard to the Scalar: 3 or 4 Wheeler, which may affect the health and safety of workers.

Start date: 4 Augustus 2016

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Compiled by: AC vd Vyver (SMIRM:UK)

**ASSESSMENT AND RECOMMENDATIONS APPROVED BY:**

Manager(s) or Responsible Person(s):

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Print Name

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Signature

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Print Name

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Signature

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## 1 Abbreviations

Explanation	
MQA:	Mine Qualifications Authority
SIMRAC:	Safety in Mines Research Advisory Committee
MHSA:	Mine Health and Safety Act, 29 of 1996, as Amended
DMR:	Department of Minerals and Recourses
TMM:	Trackless Mobile Machinery
FOG:	Falls Of Ground
COP:	Code of Practice
C:	Consequence
L:	Likelihood of Unwanted Event
RC:	Risk Criticality based on maximum reasonable consequence

## 2 Disclaimer

This risk assessment represents the view of the team members involved and does not express the view point of a single person. The methodology used to gather information and applying same to an analysis tool reflect the format required by the ISO 31000 and ISO31010 for Risk Management. The King III Report "Principle 4.11 was employed to derive at realistic recommended mitigating measures. As low as reasonable practicable (ALARP) principles were exploited during discussions. No presentation of risk levels or any other information reflected will be warranted to an accuracy level beyond the source. This is extended to the completeness of the risk analysis as well as to the reliability thereof. Risks are an uncertainty and are influenced by variable factors which react on change intermittently, likewise the assumptions made by the team members and the facilitator.

SheRisk assume no responsibility in connection with the risk analysis and indemnify us from any civil liability for any matter deriving from the report.

### 3 Introduction

The lead assessor was Mr Albert van der Vyver, Consultant with 34 years experience of Gold, Platinum, Chrome and Coal mining in the Occupational Safety, Health, Environmental and Risk field.

SheRisk are a sole member company functioning in the Risk Management field for the past 18 years and located in Bronkhorstspruit. The company specializes in occupational safety and health consultancy and offers an array of professional services, including risk analysis, training, leadership and culture management. We have the international experience and expertise to assist any organization to achieve world-class performance in occupational safety.

At the request of Aard Mining Equipment (Pty) Ltd, this Risk Assessment was compiled to meet the requirements of the Mine Health and Safety Act, 29 of 1996, as Amended, with specific reference to Section 10 (training), Section 11 (assess and respond to risk) and Section 21 (manufacturer's duties) of the Act.

Cognisance was taken of ISO/IEC 31010:2009, *Risk Management – Risk Assessment Techniques* for the drafting process.

The applicable principle to this risk assessment suggests a related best practice process where the objective is to review new equipment in terms of their hazards and risks. It is a process that:

Define triggers for risk assessment and management for new equipment and significant high potential incidents / accidents.

Apply the ALARP principle to ensure “Reasonable” measures are taken to reduce or mitigate the related hazards or risks as defined in the MHSA.

Feeds the results of risk assessments in all areas back into the Risk Register where relevant.

The Scalar: 3 or 4 Wheeler is a rigid frame machine with two drive wheels fitted with brakes on the front and either one or two wheels at the back. Fitted to the ridged frame is the double knuckle boom and scaler allowing movement in the vertical plane.

Steering and direction control is accomplished by dual foot treadle control, one for the left and one for the right side wheel motor.

Boom and hammer (Atlas Copco SB302 Hammer) controls valves are mounted on the left and right side of the driver respectively and are controller manually by hand. The hammer has a reach of approximately 7 meters from ground clearance.

The engine speed is adjusted by moving the friction handle connected to the diesel pump throttle forwards or backwards. The machine has got a 120 litre fuel capacity.

The unit have two side doors for entry into the single seater enclosed cabin. Fitted to the unit is a air conditioner for operators comfort.

The machine is hydrostatically driven with one pump and two wheel motors to drive the drive wheels. The hydrostatic system is power by a diesel engine and the electrical system is 24V.

Service braking is accomplished with hydrostatic retardation. The park/emergency brake is Spring Applied Hydraulically Released (SAHR).

**Note:**

This assessment is neither a training manual nor a servicing document. It contains only the most significant hazards and risks involved with using and associated maintenance of the Scalar: 3 or 4 Wheeler. Detail analysis of each component and failure effects or impact on the operation should be evaluated in a design assessment which might necessitate the utilisation of a different analysis methodology (e.g. FMECA). In particular this assessment covers the failure that will cause harm to person as required by Section 11 and Section 21 of the MHSA.

## 4 Executive Summary

### 4.1 Salient findings on high risks:

- a) Where the Scalar is used for draw point maintenance, scaling or hang up control in Massive open stope mining, Cave mining or Sub-level caving it would be recommended that the related section of the Mandatory Code of Practice for the Design, Development/Construction, Safe Operation and Maintenance of Draw Points, Tipping Points, Rock Passes and Box Fronts been reviewed to include the hazards and risks of this risk assessment.
- b) It is recommended that the mine conduct a formal Bow Tie Analysis to evaluate their control effectiveness of the TMM COP, and follow this up with the development of a Trigger Action Response Plan (TARP) for Scaling operations.

- c) A spotter may be required at areas prone to FOG during scaling or where the ground conditions appears to be fragile, blocky or geological anomalies is significant.

Fall of ground, hang wall in-stability or hang-ups in draw points poses a significant risk to the operator of the Aard Mining Equipment (Pty) Ltd Scalar due to the scaling operational activities that will be performed. Special care should be taken when these activities is performed in isolated areas (e.g. Single entry draw points where mud pushes may occur).

- d) The confined cabin brings a secondary hazard to the work environment, in particular “a trapped operator” following a fall of ground or collisions (which is a likely event due to the fact that the Aard Mining Equipment (Pty) Ltd Scalar will be used at the “face” area for scaling operations). The mine should develop a procedure to ensure that they can effectively recover a person trapped inside the
- e) Employers has an obligation to ensure that only competent persons fit for the task are assigned to the operation of equipment and machinery. This include metal and physical capability analysis. For this reason cognisance should be taken of the “Minimum Standards of Fitness to Work at a Mine” mandatory COP (Reference Number: DMR 16/3/2/3-A3, Effective Date: 30 June 2016).

Below a few of the aspects to note during physical capability assessment for employment, “Exclusions as drivers / operators of machinery”:

- Minimum age of persons operating machines.
- Epilepsy / Neurological state affecting level of consciousness.
- Diabetes.
- Cardiovascular (e.g. ischemic heart disease).
- Colour Blindness.
- Visual field.

Note: The Occupational Medical Practitioner should take into account local variation in job requirements as well as a worker’s experience and individual circumstances.

- f) An effective lockout system as to eliminate unauthorized access to operate should be maintained properly.
- g) The rear wheels and hammer / boom sections on the machine poses a significant risk to the extent that it should be classified as a “**no go**” area during any operations of the machine. An effective communication system might be necessary for any person who wants to enter the operational area. In any event should no person been allowed to come in close proximity or at least 4 meters from the machine when scaling operations commence.

h) Tyre pyrolysis on equipment poses a significant threat on surface and more in underground operations. As tyre explosion in a congested workspace as tunnels and workshops will allow debris to cause substantial damage and injury to person, the management of tyres and the use of Nitrogen in tyres should receive critical attention during monitoring.

- Tyres should not be inflated with air when used and allowed to cool down.
- The percentage of Nitrogen to be maintained >96% at all times.
- No machine should be used or driven with underinflated tyres.
- The mine should conduct a proper assessment of tyre pyrolysis in the context of a Bow Tie Analysis to establish mine specific control effectiveness to prevent or control explosions.
- Tyres should be changed and handled only by competent tyre handlers who understand and are trained in the pyrolysis hazards involved.

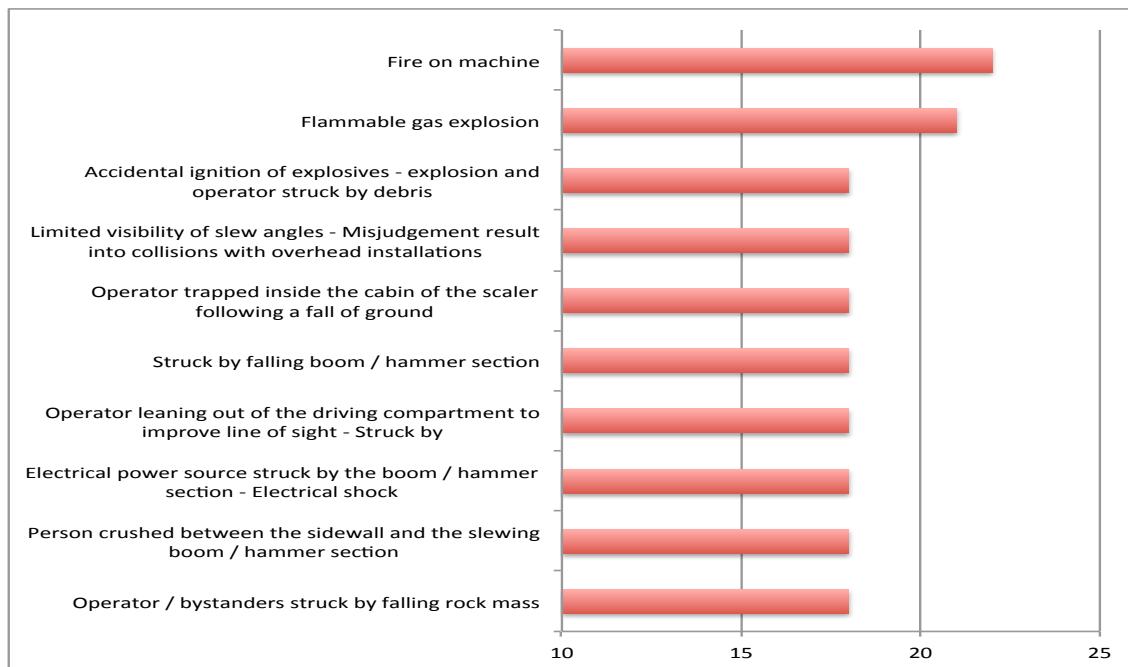
i) Rapid release of hydraulic pressure energy and vacuum conditions on hydraulic operated equipment remain the principal risk. Maintenance personnel should be aware of these risks and follow the mine specific Isolation and Lockout procedures during maintenance activities. Zero energy principles apply. Ensure adequate systems are in place to inspect and test this equipment.

j) The rapid change in road camber or the roadway condition itself poses a risk to the operator of the machine. The risk of toppling over due to overbalancing of the Aard Mining Equipment (Pty) Ltd Scalar: 3 or 4 Wheeler exists, particularly when operations takes place on uneven areas.

k) Tramming only to commence when the hammer / boom sections of the machine is in tramping position. Contact with overhead service installations pose a significant risk.

l) The use of the 3 to a 4 wheeled machine has an inherent risk towards it turning circle. Where the 3 wheeler has a smaller turn with one wheel stationary and the rear wheel that may slew at speed, the 4 wheeler has an increased turning circle. Best case scenario would be a turning circle radius of approximately 3,7 metres, in all other instances it would be 4,25 meters. The operators of both machines should be made aware of this function. If both the 3 and 4 wheeler machines are operated by the same operators with the same license, they may misjudge them with the increased or decreased turning circle.

## 5 Risks profile



## 6 Objectives

The primary **objective** of this risk assessment is to identify and evaluate the situations, activities and geographical areas, which could lead to an unwanted event / mishap. Furthermore, to develop effective controls to limit the exposure to unnecessary risks or any other unrecognised energy build-up with potential negative results.

**Secondary**, to provide the user with the necessary information to institute reasonable practicable measures in dealing with the identified significant risks, more specific:

To develop control measure in the event of operational failure.

To provide an indication of critical aspects to be consider during normal and abnormal conditions.

To assist in the development of “**no go**” conditions.

Also management of the changes that might be encountered.

To provide “**trigger action points**” for action by the front line supervisor and operator of the machine.

## 7 Scope (Context and Boundaries)

This assessment is done taking cognisance of the interactions between all possible surface and underground conditions in as far as the handling / operating, proper use and limitations of the Aard Mining Equipment (Pty) Ltd Scalar: 3 or 4 Wheeler is concerned.

This assessment covers only the product as supplied by Aard Mining Equipment (Pty) Ltd. Any changes, alterations, misuse or abuse or the use of any pirate part by the user or its employees to the Scalar: 3 or 4 Wheeler will not form part of this assessment.

The assessment includes all geographical and functional hazards as well as all energy sources, which were known to the assessment team at the time of the assessment.

In lieu of the fact that this assessment project covers a large number of activities involved with trackless operations throughout the mining industry, some issues may have been inadvertently omitted. If in future such an issue is raised, it will be dealt with as a review of this document.

Focus was placed on aspects meeting the objectives of the assessment and any area, activity or situation not covered in this assessment and or whenever there is a change, of any nature, which might affect the level of risk as assessed by the original team members, additional assessments will need to be carried out.

### 7.1 Related documents

**SIMRAC** projects on accident causal analysis for Mining Mobile Machinery:

Investigation of the causes of transport and tramming accidents on mines other than Coal, Gold and Platinum. Project No. OTH 202.

Noise levels in current and new equipment. Project No. GEN 420.

Illumination and visibility standards. Project No. COL 451.

Investigation into the influence of haul road design, construction and maintenance practices on transport accidents for surface and underground mines. Project No. OTH 308.

## **8.8. General Machinery Regulations**

(1) *The employer must take reasonably practicable measures to prevent persons from being injured as a result of them, the clothes being worn by them or any equipment being held by them coming into contact with or being drawn into any moving part of any machine.*

(3) *The measures to be taken by the employer in terms of regulation 1 must include measures to ensure that -*

(a) *only persons authorized by the employer to do so, start operate and maintain any machine where such starting, operation or maintenance may pose a significant risk to any person;*

(c) *only persons authorised by the employer to do so enter any area where machinery is operated, where such operation may pose a significant risk to any person;*

(d) *machinery is only operated if all installed safety devices are operational and functional;*

(f) *where the unexpected moving of any machinery or any part of any machinery could pose a significant risk to any person, appropriate pre-start warning devices, such as audible warning devices, the delay time must be determined by risk assessment with a minimum of a ten second time delay, are fitted to such machinery and used to warn persons that such machinery is about to be set in motion;*

(g) *here there could be a significant risk to any person working on any machinery due to the release from such machine of any mechanical, electrical, hydraulic, chemical or other source of energy, a written lockout procedure is prepared and implemented to ensure that such source of energy is effectively locked out and de-energised before any person works on such machinery;*

(4) *The measures to be taken by the employer to prevent any person from coming into contact with any moving part of machinery or any equipment attached thereto, must include -*

(a) *effective physical barriers at the machinery such as screening, guarding or fencing; or*

*(b) failsafe electric or electronic barriers interlocked with the machinery in such a way that the machinery would be stopped before persons come into contact with moving machinery or parts thereof; or*

*(c) effective barriers at a safe distance away from any machinery.*

## 7.2 Mandatory Codes of Practice

The following codes have an impact on the outcome of this risk assessment and the mine should evaluate the site-specific changes and interaction created between Codes.

a) **Trackless Mobile Machinery COP No. DMR 16/3/2/2-A2.**

With reference, but limited to the following items from the COP:

*8.1 Safe use of TMMs, equipment and tools*

*The employer must ensure that a management system is in place that ensures that TMMs as well as accompanying equipment and tools are used within their design capacity.*

*8.5 Safe boarding/alighting and /or access to/exit from TMMs*

*The design of equipment and procedures to provide for the safe boarding onto, alighting from, riding on or working on top of TMMs.*

*8.10.1 Appropriate measures to ensure maintenance work in workshops; work bays or any controlled environment in the field or at the face can be undertaken safely.*

*8.10.7 The adequate support of a TMM or any of its components which may inadvertently fall on persons.*

*8.12.1 Procedures and criteria to recruit/select, educate, train and appoint competent persons to operate or drive TMMs.*

*8.12.2 Awareness education and training in terms of the interaction with TMMs, of persons working or travelling in close proximity to the TMM, in compliance with the MHSA.*

*8.13.2 Safe height, width and turning circle clearances.*

## 8 Methodology

### 8.1 Risk Assessment Method

The application of the WRAC, although not focusing on the decision to be taken but rather on the *worst potential events*. Primarily to determine the activities, which have the greatest potential to create production delays, injuries and other downtime incidents including those with financial impact.

Potential causes and consequences of each activity were identified and listed to assist with the development of control measures. These findings were assessed using a Risk Matrix and ranked accordingly to priority.

The WRAC method requires a team approach and systematically covers the total issue, equipment, activity, structure, hazard, process or sub-process under assessment producing a risk profile. The tool provide for a process of evaluating the risks arising from hazards taking into account the adequacy of any existing controls ("risk analysis") and deciding whether or not the risks are acceptable, when compared to acceptable risk criteria or goals.

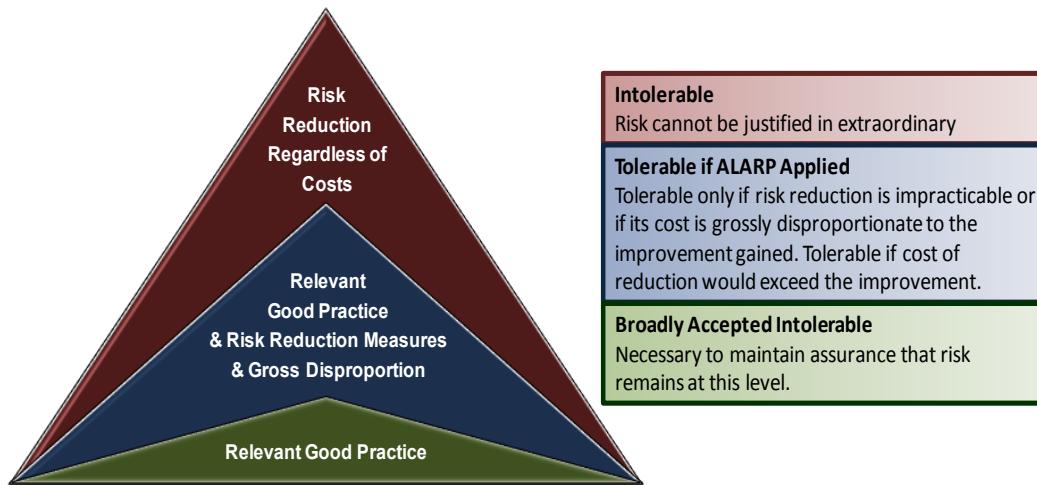
### 8.2 Risk Analysis Method

The complexity of the operations and interaction with other machinery in the confined environment increase the chance of a major event taking place and therefore necessitate the use of a *qualitative approach for the Analysis*, not only because of the lack of data for a quantitative analysis, but predominantly as a result of the conceivable impact involved.

The evaluation consists of three phases; likelihood estimation, Impact result and detectability of the failure or trigger event.

Risk importance is calculated by the product of the aforementioned. Further reference to this is made at the section depicting the graphs and summary of findings.

The **ALARP** (As Low As Reasonably Practicable) test indicates the appropriate level of expenditure that should be incurred to reduce the risk and is intended to prevent inappropriate or excessive costs being incurred for risk control.



### 8.3 Control and effectiveness criteria

The following Hierarchy of Control, adopted in the Occupational Health and Safety Act, Act 29 of 1996, as Amended, offers a good framework for considering the effectiveness of controls (Section 11).

The effectiveness of a control barrier decreases from top to bottom of the list. In practice the closer the control measure is to the top of the hierarchy, the more potentially effective the control.

- Eliminate the hazard or energy source (do not use the energy).
- Minimise or replace the hazard or energy source (reduce the amount of energy to a less damaging level or replace the energy with another that has less potential negative consequences).
- Control the hazard or energy using engineered devices (e.g. lock outs, mechanical support, gas monitors, etc.)
- Control the hazard or energy by using physical barriers (e.g. machine guarding, etc.)
- Control the hazard or energy with procedures (e.g. isolation procedures, standard operating procedures, etc.)
- Control the hazard or energy with personal protective equipment (e.g. hard hats, boots with toe caps, gloves, safety glasses, welding gear, etc.)

## 9 Definitions

### **Consequence**

The outcome of an event or situation expressed qualitatively or quantitatively, whether a loss, injury, health or environment impact, or disadvantage, or a benefit, gain or advantage.

### **Control**

Control or barrier is defined as “anything used to control, prevent or impede energy flows or the loss of control of a hazard”. It is essential to consider controls or barriers in terms of their order of greatest effectiveness.

### **Likelihood**

The likelihood or chance that an unwanted event will occur.

### **Hazard**

A source of potential harm to people, facilities, the environment or the community that, should it involve potential damage, will be an '**energy**' such as electricity, pressure, chemical, etc. The environmental term, "aspect", is synonymous with hazard. A hazard must be recognised and understood in order to manage the related risk. Understanding a hazard includes the nature, magnitude, and potential consequences as well as relevant "target" or impact characteristics, potential timeframes, pathways or mechanisms of its manifestation and residual harm. Also, understanding sources of harm to the community may require recognition of incentives.

### **Risk**

A combination of the likelihood of an occurrence of a hazardous event or exposure and the severity of the impact (e.g. injury, illness, environmental impact) that may be caused by the event or exposure.

### **Risk rating**

Determination of the risk level associated to unwanted events by means of likelihood of occurrence and consequences; normally use to prioritize risk management efforts.

### **Unwanted Event**

An incident or situation which occurs in a particular place during a particular interval of time. Unwanted events involve releases or manifestations of, or exposures to the hazard.

## 10 Summary of Recommendations

Following a proper process in analysing the information obtained from the WRAC Worksheets the team made the recommendations with focus on eliminating or reducing the high potential risk areas.

### 10.1 Procedures

The mines Code of Practice for Trackless Mobile Machinery should be re-evaluated against the findings of this assessment. Areas that might need attention are listed below:

- a) Remedial actions preventing unauthorized riding / operating of the Scalar: 3 or 4 Wheeler machine.
- b) Circumstances under which the Scalar: 3 or 4 Wheeler machine should not be used, "No Go" conditions.
- c) Testing service, park and emergency brakes. (To include static tests, dynamic test and test facilities such as ramps, SIMRET test should be considered.) To read with the new regulations under Chapter 8 of the MHSA.
- d) Visibility of the machine and persons, reflective clothing, warning signs and systems, etc.
- e) Procedures and other governing documentation for dust and flammable gas should take into account legislation Chapter 5.1(1) (b) & Chapter 9.2(2) (a), of the MHSA.
- f) Access or permission to entrances of inclined workings, cambered roadway operations, the machine limitations and excavations.
- g) Emergency preparedness and response.
- h) Changing / repair on tyres.
- i) Repairs on electrical systems endangering persons.
- j) Support of the machine or parts; of which may inadvertently fall.
- k) Rigging, slinging and transport of the vehicle to the working areas / operating site.

- I) Maintenance to include established approved work bay's, workshops or other controlled environment as well as breakdowns in unsafe work areas, scheduling inspections / over-inspections, checklists, repairs endangering persons, hazardous substances, non-approved parts and substances, cutting and welding, gravity imbalances, stored energy and hot surfaces.

## 10.2 Training

Findings from this assessment should be incorporated into the training manuals of the mine (Sect. 10 of the MHSA).

- a) All workers, contractors and visitors working in the vicinity, travelling or who are exposed to trackless operations in any way, should be educated in the identification of hazards and the required actions. The initial / refresher training and induction programme should deal with this information transfer.
- b) Ensure sequential activities indicating significant hazards, risks, causes and consequences of deviations are in fact dealt with in training manuals.
- c) On-the-job training (**performance assessments**) should form an integral part of the supervisor's daily workplace risk assessment programme.
- d) Records of underground / surface training to be documented properly and kept on the personal file of each individual operator to evaluate for medical examination / surveillance programme.
- f) **Physical and mental capability assessments:** The selection criteria for operators for the use of remote control operations to include items such as co-ordination, reaction time, attention span, eyesight, angle of vision, night or colour blindness, hearing, depth perception, aggressiveness, age, anthropometrics.

## 10.3 Operational Issues

The utilization of the Scalar: 3 or 4 Wheeler machine in the workplace should form part of the mines own risk assessment programme (geographical assessment). Many changes to working conditions could arise which are beyond the control of Aard Mining Equipment (Pty) Ltd.

- a) It is recommended that mines investigate the feasibility to install anti-collision proximity devices for trackless mobile machines where the Issue Based Risk Assessment has indicated that it is a "significant risk". Ensure the requirements of Regulation 8 of the MHSA are followed, include the related SANS codes referred to in the regulations.

- b) Under no circumstances should any form of alteration be made to the Scalar: 3 or 4 Wheeler machine as supplied and should be used only for the purpose it was originally designed for.
- c) The mine should complete the Legal Impact Analysis to ensure that they conform to regulatory requirements. The recommendations should be scheduled with proper commitment date, follow up and verification.
- d) Brake testing should be done prior and during the shift at intervals and areas as determined by the responsible engineer. The geographical conditions may vary and the onus should be on the operator and front line supervisor to indicate these areas for brake testing. Any form of failure, malfunctioning or deviation from the normal test results should be treated as a “no go” condition, and use of the machine terminated until such repairs as may be necessary to restore the brakes has been taken. Read in accordance to the Regulation for TMM's in Chapter 8 of the MHSAs.
- e) A significant risk of collision and runaway will require a recommendation to retard / limit the machine operations under certain conditions or avoiding speeding when used at inclined and declined working areas. It would be the responsibility of the appointed 2.13.1 appointed Engineer to execute such recommendations based on his own risk assessment of geographical application aligned with the Mines Specific Code of Practice for Trackless Mobile Machinery.
- f) Operators and other employees working in the close proximity of scaling operations should be aware of the danger zone within and around the Aard Mining Equipment (Pty) Ltd Scalar. The danger zone implies the area, which an exposed person is subject to a risk to his health or safety.
- g) Mines should be aware that the possibility of flammable gas in underground operations would always exist. The scaler hammer has the potential to release enough energy to ignite flammable gas and for that reason proper making safe precautions should be establish prior to scaling activities.
- h) A procedure should be developed for the rescue of the operator in the event of a major fall of ground and the person is trapped in the operator cabin.
- i) Ensure that the vehicle is in the trammimg mode prior to moving off. Trammimg with the machine pose a significant treat to collision with overhead service installations, it will also reduce the line of sight of the operator. Ensure that training material include these significant risks.
- j) No material, equipment may be transported with the Scalar: 3 or 4 Wheeler machine.

- k) Repair to hydraulic systems is always specialised work, which requires practical knowledge and skill. For repairs to the hydraulic pumps, hydraulic motors, etc. it is recommended that the entire unit be changed for a new or serviced exchanged part. Ensure test certificates are obtained from the 3<sup>rd</sup> party company doing the repairs. ~~Avoid the use of non-approved (pirate) parts~~
- l) Special attention should be given to ensure the quality of lubrication oils is as recommended, strict cleanliness observed and correct oil levels maintained.
- m) The mine should take into account the turning circle for roadway design and operational parameters. The difference between the Scalar with a 3 or 4 Wheel configuration increased the turning circle radius of the machine when in operational mode.
- n) No other person will be allowed to travel on the machine apart from the operator inside the cabin.
- o) Nip points as well as the wheel and hammer boom sections pose a significant risk, therefore operators and maintenance personnel should be aware of these nip points and adhere to the demarcation and warning notices on the machine.
- p) The mine should conduct **formal task analysis** for each maintenance and operating activity to identify additional exposures as per Sect 11 of the MHSA. The technical and operational manuals should be used in addition to this assessment to ensure full compliance.
- q) 3rd Party re-vamping of hydraulic cylinders should include assessment of skirt dimensions and issue certificate that it conform with original design specifications.
- r) The energy released during scaling has the potential to ignite and set off explosives under certain conditions. Ensure that making safe and treatment of misfires and sockets are enforced properly.

## 11 Implementation and Approval Process

The mines formal safety management program should be used to implement the findings of the risk assessment and should include, but not limited to the following elements; communication, responsibilities, follow up system, audits, promotion, selection and placement, emergency preparedness, re-training and committees.

An example of an implementation plan indicated below should be drafted and monitored by a person designate with the responsibility.

Hazard Identified	Existing Controls	Recommended New Controls	Specific Action	Accountability	Target Date	Compl Date

The information for the first three columns has to be developed from the outcome of this Risk Assessment.

An action plan review date should be set to ensure all required “Actions” are in fact completed or on schedule.

## 12 Conclusion

Notwithstanding the above recommendations, every supplier / manufacturer has a duty to inform the user of any hazards and risks associated with his product. Conversely, every Manager, Shift / Production Supervisor and employee should continue to take all reasonable practical measures to provide a healthy and safe work environment.

The Scalar: 3 or 4 Wheeler machine is used under different conditions underground. Care should be taken as these conditions may vary from site to site. Geographical assessments are essential to the use of any trackless mobile machine, underground as well as on surface.

The front line supervisor remains the key person in eliminating and or reducing the possible hazards that could be encountered.

Activity / Process	Energized hazards List the processes, activities, equipment or component	Way to look for hazards - A source of potential harm to people, facilities or the environment or the community	Magnitude of Hazard (Quantity)	Release Mechanism of Hazard/Energy	Maximum Reasonable Consequences (S.H.E)	Controls		Comment / additional controls by the Risk Owner or for implementation / Enhancement of existing controls (Please detail)
						Hierarchy of control	Risk Rating	
Operating and Maintaining	Chemical	Hydrocarbons (Oil, lubrication materials, cleaning materials, etc.)	Mechanical failure, Leakages, Manual handling, Material/mental fatigue	Safety	Slippery surface from spillages - Slip & fall on the machine	Housekeeping, Spill kits, Planned maintenance, Pre-start inspections	Administrative 2: Unlikely	3: Mod 9 (M)
Operating and Maintaining	Chemical	Hydrocarbons (Oil, lubrication materials, cleaning materials, etc.)	Mechanical failure, Leakages, Manual handling, Material/mental fatigue	Safety	Slippery surface from spillages - Slip & fall on same level	Housekeeping, Spill kits, Planned maintenance, Pre-start inspections	Administrative 2: Unlikely	3: Mod 9 (M)
Operating and Maintaining	Chemical	Hydrocarbons (Oil, lubrication materials, cleaning materials, etc.)	Mechanical failure, Leakages, Manual handling, Material/mental fatigue	Safety	Spillage with contamination of process water	Housekeeping, Spill kits, Planned maintenance, Pre-start inspections, MSDS, Oil separation in workshop, Sumps in workshops, Dip trays for maintenance activities	Administrative 4: Likely	2: Min 12 (M)
Operating and Maintaining	Chemical	Hydrocarbons (Oil, lubrication materials, cleaning materials, etc.)	Mechanical failure, Leakages, Manual handling, Material/mental fatigue	Safety	Spillage with soil contamination	Gloves, Goggles, Long sleeve overalls, Boots, Planned maintenance, MSDS, Pre-start checklist	Administrative 4: Likely	2: Min 12 (M)
Operating and Maintaining	Chemical	Diesel (approx 120 litres), Other hydrocarbons	Spillages in contact with ignition sources (Electrical short circuit, Engine undo, Hot surfaces (Manifolds), etc.)	Safety	Fire on machine	COP Prevention of underground fires and explosions, COP Emergency Preparedness and Response, Fire fighting equipment, Fire fighting suppression systems, Fire extinguishers, Refuge bays	Administrative 3: Possible	5: Maj 22 (H)
Operating and Maintaining	Chemical	Old Explosives, misfires, contained in sockets	Friction between rock during scaling, Hammering energy during scaling operations	Safety	Accidental ignition of explosives - explosion and operator struck by debris	Ensure that a competent person appointed by the engineer inspects the working area and treat any suspected material in explosives accordance with the procedures for explosives and old explosives	Administrative 3: Possible	4: High 18 (S)
Operating and Maintaining	Chemical	Cleaning solvents	Application to clean machine during maintenance	Safety	Contact with chemicals - dermatitis	Gloves, Goggles, Long sleeve overalls, boots, Planned maintenance, MSDS, Pre-start checklist, Procedures to use high pressure washers	Administrative 4: Likely	2: Min 12 (M)
Operating and Maintaining	Chemical	>1.4 % Flammable gas	Displacement, released into the workplace through geological anomalies, release during FOG as a result from scaling	Safety	Fire or explosion	COP Prevention of underground fires and explosions, COP Emergency Preparedness and Response, Gas monitoring instruments, Safe declaration by competent person	Administrative 4: Likely	4: High 21 (H)
Operating and Maintaining	Chemical	Battery acid	Leaks, Overfilling	Safety	Acid burns	MSDS, Gloves, Goggles, Acid proof clothing	Administrative 3: Possible	2: Min 8 (M)
Operating and Maintaining	Chemical	Battery acid	Leaks, Overfilling, Contact with other corrosive materials	Safety	Spontaneous combustion - fire	COP Prevention of underground fires and explosions, Ventilation standards, Charging bays ventilated into return airways	Administrative 1: Rate	3: Mod 6 (M)
Operating and Maintaining	Chemical	On-board batteries	Charging - Release of hydrogen gas during charging	Safety	Battery Explosion	COP Occupational Health Care Programme for Airborne Pollutants, Ventilation standards, Monitoring of amount of diesel vehicles and fuel emissions in a given production area	Administrative 3: Possible	3: Mod 13 (S)
Operating and Maintaining	Dust / Inhalable particulates	>0.063 m³/s/kw Diesel particles	Internal combustion of diesel engines	Health	Inhalation of diesel particulates above the Occupational Exposure Limit (OEL)	COP Occupational Health Care Programme for Airborne Pollutants, Dust suppression systems should be considered for loading material, Ventilating down area, Enclosed cab for operator, Dust monitoring systems	Administrative 3: Possible	2: Min 8 (M)
Operating and Maintaining	Dust / Inhalable particulates	>3mg/m³ PNOC	Other Trackless equipment tipping or transporting material, Sealing of the face area, Liberation from material	Health	Inhalation of dust particles (Bronchi irritation)	COP Occupational Health Care Programme for Airborne Pollutants, Dust suppression systems should be considered for loading material, Ventilating down area, Enclosed cab for operator, Dust monitoring systems	Administrative 3: Possible	2: Min 8 (M)
Operating and Maintaining	Dust / Inhalable particulates	>0.1 mg/m³ Crystalline Silica (only on mines where applicable)	Other Trackless equipment tipping or transporting material, Liberation from material	Health	Inhalation of dust particles with subsequent irreversible health impact	Administrative 2: Unlikely 4: High 14 (S)		

Activity / Process	Energy hazards List the processes, activity, equipment or component	Way to look for hazards - A source of potential harm to people, facilities or the environment or the community	Magnitude of Hazard (Quantity)	Release Mechanism of Hazard/Energy	Maximum Reasonable Consequences (S.H.E)	Unwanted event	Controls		Comment / additional controls by the Risk Owner or for implementation / Enhancement of existing controls (Please detail)
							Hierarchy of control	Likelihood	
Operating and Maintaining	Dust / Inhalable particulates	> 50 ppm CO	Internal combustion of diesel engines	Health	Inhalation of CO fumes	COP Occupational Health Care Programme for Airborne Pollutants. Enclosed cab for the operator of the scaler	Administrative	3: Possible	2: Min - 8 (M)
Operating and Maintaining	Electrical	24 Volt DC on-board battery	Overcharging, Jump start, Short circuit, Vibration from fraying, Hot connections, Unintended alternative current flow, Stay voltage, Induction from other sources	Safety	Ignition source for fire or explosion	Ventilation standards. Environmental monitoring systems. Emergency teams. Re-use inspections of electrical systems, Planned maintenance programme, Thermal circuit breaker to prevent overloading. Fuses, isolation and lock out procedures, Refuge Days. Self contained self requires, Jumpstarting procedure	Engineering	1: Rare - 5: Maj	15 (S)
Operating and Maintaining	Electrical	24 Volt DC on-board battery	Overcharging, Jump start, Short circuit, Vibration from fraying, Hot connections, Unintended alternative current flow, Stay voltage, Induction from other sources	Safety	Smouldering releasing noxious gasses	Ventilation standards. Environmental monitoring systems. Emergency teams. Re-use inspections of electrical systems, Planned maintenance programme, Thermal circuit breaker to prevent overloading. Fuses, isolation and lock out procedures, Refuge Days. Self contained self requires, Jumpstarting procedure	Engineering	2: Unlikely - 4: High	14 (S)
Operating and Maintaining	Electrical	24 Volt DC on-board battery	Overcharging, Jump start, Short circuit, Cable or insulation fatigue, Hot connections, Vibration from fraying, Unintended alternative current flow, Stay voltage, Induction from other sources	Safety	On-board fire	Ventilation standards, Environmental monitoring systems, Emergency teams. Re-use inspections of electrical systems, Planned maintenance programme, Thermal circuit breaker to prevent overloading. Fuses, isolation and lock out procedures, Refuge Days. Self contained self requires	Administrative	3: Possible	5: Maj - 22 (H)
Operating and Maintaining	Electrical	24 Volt DC on-board battery	Overcharging, Jump start, Short circuit, Cable or insulation fatigue, Hot connections, Vibration from fraying	Safety	Operator trapped inside machine on fire	Administrative	1: Rare	4: High	10 (M)
Operating and Maintaining	Electrical	24 Volt DC on-board battery	Overcharging, Jump start, Short circuit, Vibration from fraying	Safety	Explosion of battery	Planned maintenance practices. Avoid any jump start of the machine - replace battery	Administrative	2: Unlikely	4: High - 14 (S)
Operating and Maintaining	Ergonomics	Operator's seat, Body postures, Exposure task requirements, Fitness to work, Prolonged time	Paullened in cab, workers' capabilities and exposure	Health	Muscular fatigue	Design of the seat. Official breaks suggested. Operator outside of cabin during shift changes. Fatigue management COP	Administrative	2: Unlikely	2: Min - 5 (L)
Operating and Maintaining	Ergonomics	Field of view alignment, Visual perception	Workstation layout, Location and orientation of work, Workers anthropometric characteristics	Safety	Limited visibility of boom activities and angles - Misjudgements result into collisions with overhead installations	Ensure that operators comply with the COP for minimum fitness standards to work on a Mine. Adhere to fatigue management COP requirements. Operators should be aware of blind spots created by the boom and hammer during saw and scaling. Safe scaling practices	Administrative	3: Possible	4: High - 18 (S)
Operating and Maintaining	Explosives	Old explosives, Misfires, Sockets not washed properly	Scaling of the face or scaling in close proximity of a hole or socket containing explosives	Safety	Accidental ignition of a misfire or holes contained explosives - Explosion and struck by debris	Inspect that a competent person appointed by the engineer in accordance with the procedures for explosives and old explosives	Administrative	2: Unlikely	4: High - 14 (S)
Operating and Maintaining	Gravitational (Objects)	Geological structures	Faults, Slips, Intrusions, Change in ground composition and rock characteristics	Safety	Rock dislodgement when scaling of the face area and struck by fall of ground	COP to Combat Rock Mass Failure / Fall of ground / roof, Competent A & B Inspections & Safe declarations, Rehabilitation of support installations, Rock engineering inspections and recommendations, Design, Development/Construction, Safe Operation	Administrative	3: Possible	4: High - 18 (S)
Operating and Maintaining	Gravitational (Objects)	Rock mass	Weathering, Changes in stress fields, Changes in ground conditions	Safety	Rock dislodgement and struck by fall of ground	COP to Combat Rock Mass Failure / Fall of ground / roof, Competent A & B Inspections & Safe declarations, Rehabilitation of support installations, Rock engineering inspections and recommendations, Design, Development/Construction, Safe Operation	Administrative	3: Possible	4: High - 18 (S)
Operating and Maintaining	Gravitational (Objects)	Rock mass	Scaling of the face, Loose rock mass not identified, Hydraulic forces applied by the scaler on loose rock	Safety	Operator / bystanders struck by falling rock mass	COP to Combat Rock Mass Failure / Fall of ground / roof, Competent A & B Inspections & Safe declarations, Rehabilitation of support installations, Rock engineering inspections and recommendations, Design, Development/Construction, Safe Operation	Administrative	3: Possible	4: High - 18 (S)
Operating and Maintaining	Gravitational (Objects)	Rock mass	Deterioration of previously installed support, Geological structures, Stress fields, Weathering of ground, Hydraulic forces applied to scale the face	Safety	Operator trapped inside the cabin of the scaler following a fall of ground	Emergency preparedness and response, Recovery of persons Procedure to be followed in the recovery of a person trapped inside the enclosed cabin of the scaler following a fall of ground	Administrative	3: Possible	4: High - 18 (S)
Operating and Maintaining	Gravitational (Objects)	Height of cabin	Embarking / Disembarking of machine for operations, Conducting a pre-start, Housekeeping, Maintenance activities	Safety	Slip or trip and fall to toolwall	Use a 3 contact rule when boarding or alighting the machine, Housekeeping, Ensure no loose material or equipment inside the operators cabin on the machine, Housekeeping, Non-slip strips, PPE	Administrative	3: Possible	3: Mod - 13 (S)

Activity / Process	Energy hazard	Way to look for hazards - A source of potential harm to people, facilities or the environment or component	Magnitude of Hazard (Quantity)	Release Mechanism of Hazard/Energy	Maximum Reasonable Consequences (S.H.E)	Unwanted event		Controls	Comment / additional controls by the Risk Owner or for implementation / Enhancement of existing controls (Please detail)
						Likelihood of occurrence	Risk rating		
Operating and Maintaining	Lighting	Inadequate illumination				Operator leaning out of the driving compartment to improve line of sight struck by or caught between two machines or objects	Safety	Ensure all lights on the machine are in good working condition. Light should not reflect and hand on controls are in clear view. Maintenance personnel to ensure adequate mounting placement and direction of lights. The position of the lights to indicate the total width of the machine. If not operators and all workers in the operational area should be familiar with the clearances required to the oncoming lights. All framways have to be illuminated in	Administrative 3: Possible 4: High 18 (S)
Operating and Maintaining	Mechanical (Fixed)	Hammer and boom on the scalar machine				Struck by boom when positioning for scaling operations	Safety	Remove all bystanders prior to scaling / maintenance operations. Ensure zero energy potential during maintenance. Ensure vacuum conditions are supported during maintenance to avoid unauthorised movement. Ensure lock pins is used on the boom	Administrative 3: Possible 4: High 18 (S)
Operating and Maintaining	Mechanical (Fixed)	Hammer and boom on the scalar machine				Struck by falling boom / hammer section	Safety	Planned maintenance. Pre-use inspections of electrical systems and tests. After maintenance tests to be performed. SWL indications on the equipment. Enforce the rule with task observations	Administrative 3: Possible 4: High 18 (S)
Operating and Maintaining	Mechanical (Fixed)	Hammer and boom on the scalar machine				Person crushed between the sidewall and the slewing boom / hammer section	Safety	Remove all bystanders from the danger zone prior to scaling operations. Longer and authorised operators as appointed by the relevant responsible person. Planned Maintenance. Pre-start Inspections	Administrative 3: Possible 4: High 18 (S)
Operating and Maintaining	Mechanical (Fixed)	Hammer and boom on the scalar machine				Caught into hip points	Safety	No person to be allowed to enter the danger zone. Maintenance personnel should be familiar with the risks of movement during maintenance and tests of equipment.	Administrative 3: Possible 4: High 18 (S)
Operating and Maintaining	Mechanical (Fixed)	Hammer and boom on the scalar machine				Struck by cylinder	Safety	Adhere to the equipment design and operational specifications and limitations and indicated in technical manuals, pre-use inspections. Planned maintenance	Administrative 2: Unlikely 3: Mod 9 (M)
Operating and Maintaining	Mechanical (Fixed)	Hammer and boom on the scalar machine				Mechanical failure due to loss of structural integrity of the boom or grab installation	Safety	Ensure that the boom / hammer is used only for what it was designed for. Avoid the adding additional functions to the equipment. Any damage should be assessed by a structural and design engineer with an update of this risk assessment. Use only approved service providers and approved parts for maintenance and repairs. Ensure proper repairs are kept with test certificates from accredited bodies	Administrative 2: Unlikely 3: Mod 9 (M)
Operating and Maintaining	Mechanical (Fixed)	Hammer and boom on the scalar machine				Mechanical / hydraulic failure - Struck by or caught into falling equipment / objects	Safety	Operational heights should be limited with engineering control (designed into) where the possibility exists or collision of boom / hammer should not be seen with the calculated hash zone of overhead other electrical installations. The responsible persons should take account limitations and design parameters of the machine to assess clearances to electrical overhead installations	Administrative 3: Possible 4: High 18 (S)
Operating and Maintaining	Mechanical (Fixed)	Hammer and boom on the scalar machine				Electrical power source struck by the boom / hammer section - Electrical shock	Safety	Operational heights should be limited with engineering control (designed into) where the possibility exists or collision of boom / hammer should not be seen with the calculated hash zone of overhead other electrical installations. The responsible persons should take account limitations and design parameters of the machine to assess clearances to electrical overhead installations	Administrative 3: Possible 4: High 18 (S)
Operating and Maintaining	Mechanical (Fixed)	Hammer and boom on the scalar machine				Exposed cylinder or shaft struck against overhead installation with less than structural integrity - Subsequent attachment to failure	Safety	TMM COP. Roadway maintenance. Adhere to the machine operating parameters and limitations. Trained and authorized operators. Task K Observations. Planned maintenance as per And Mining Equipment Technical Manual required. Physical capability analysis of operators. Fatigue management	Administrative 2: Unlikely 3: Mod 9 (M)
Operating and Maintaining	Mechanical (Mobile)	Mobile Machine during tramming and positioning				Roadway conditions, roadway camber change gradient or roadway and drilling site, Mechanical defect or fatigue, Malfunctioning	Safety	Man-machine as well as machine to machine fail bound equipment to be assessed at each mine to determine significant risks in order to implement warning and eldant collision avoidance systems.	
Operating and Maintaining	Mechanical (Mobile)	Mobile Machine during tramming and positioning				Skidding result into collision	Safety	TMM COP. Roadway maintenance. Adhere to the machine operating parameters and limitations. Trained and authorized operators. Task K Observations. Planned maintenance as per And Mining Equipment Technical Manual required. Physical capability analysis of operators. Fatigue management	Administrative 3: Possible 4: High 18 (S)
Operating and Maintaining	Mechanical (Mobile)	Mobile Machine during tramming and positioning				Person been run over	Safety	TMM COP. Roadway maintenance. Adhere to the machine operating parameters and limitations. Trained and authorized operators. Task K Observations. Planned maintenance as per And Mining Equipment Technical Manual required. Physical capability analysis of operators. Fatigue management	Administrative 2: Unlikely 4: High 14 (S)

Activity / Process	Energy hazards List the processes, activities, equipment or component Way to look for hazards - A source of potential harm to people, facilities or the environment or the community	Magnitude of Hazard (Quantity)	Release Mechanism of Hazard/Energy	Maximum Reasonable Consequences (S,H,E)	Unwanted event	Controls		Consequence of Risk	Risk Rating	Comment / additional controls by the Risk Owner or for implementation / Enhancement of existing controls (Please detail)
						Hierarchy of control	Likelihood			
Operating and Maintaining	Mechanical (Mobile)	Mobile Machine during trammimg and positioning	Restricted line of sight, concealed entries into roadway, leight & height of the machine roadway.	Safety	Collision between machines	TMM COP, Roadway maintenance, Training of operators, Task Observations, Concealed entries should be demarcated and hoist used to pass - operator may have to stop and clear the roadway prior to passing	Administrative 3: Possible	4: High	18 (S)	
Operating and Maintaining	Mechanical (Mobile)	Machine during trammimg and positioning	Loss control over machine	Safety	Runaway machine - collisions	TMM COP, Roadway maintenance, Adhere to the machine operating parameters and limitations, Training of operators, Task Observations, Planned maintenance as per Aard Mining Equipment Technical Manual required, Brakes tests - Static and dynamic, Fail safe brake system	Administrative 3: Possible	4: High	18 (S)	
Operating and Maintaining	Mechanical (Mobile)	Machine during trammimg and positioning	Loss control over machine	Safety	Collision with structures	Operator to ensure all energy is properly closed off and locked out at end of shift. An effective lockout system as to eliminate unauthorized access to operate should be maintained properly. No person allowed in the danger zone. Only persons appointed by the responsible engineer may operate the machine	Administrative 3: Possible	4: High	18 (S)	
Operating and Maintaining	Mechanical (Mobile)	Operating the machine	Unauthorized access to / and operate	Safety	Caught between machine and object (sidewall/rail side, structure)	Operating parameters of the machine should be taken into account during planning and mining layouts. Restricted areas to be demarcated properly in accordance with regulations. The responsible persons should take into account limitations and design parameters of the machine to assess clearances to electrical overhead installations. Only persons appointed by the responsible engineer may operate the machine	Administrative 3: Possible	4: High	18 (S)	
Operating and Maintaining	Mechanical (Mobile)	Restricted work area		Safety	Person caught between machine and object or other machine	Operating parameters of the machine should be taken into account during planning and mining layouts. Restricted areas to be demarcated properly in accordance with regulations. The responsible persons should take into account limitations and design parameters of the machine to assess clearances to electrical overhead installations. Only persons appointed by the responsible engineer may operate the machine	Administrative 3: Possible	4: High	18 (S)	
Operating and Maintaining	Mechanical (Mobile)	Restricted work area		Safety	Inadequate rib side / hanging wall or roof clearances, incorrect mining layout, Incorrect stacking and storage of material and equipment / incorrect positioning of equipment/transformers, incorrect / unsafe parking of other machines	Operating parameters of the machine should be taken into account during planning and mining layouts. Restricted areas to be demarcated properly in accordance with regulations. The responsible persons should take into account limitations and design parameters of the machine to assess clearances to electrical overhead installations. Only persons appointed by the responsible engineer may operate the machine	Administrative 3: Possible	4: High	18 (S)	
Operating and Maintaining	Mechanical (Mobile)	Restricted work area		Safety	Inadequate rib side / hanging wall or roof clearances, incorrect mining layout, Incorrect stacking and storage of material and equipment / incorrect positioning of equipment/transformers, incorrect / unsafe parking of other machines	Operating parameters of the machine should be taken into account during planning and mining layouts. Restricted areas to be demarcated properly in accordance with regulations. The responsible persons should take into account limitations and design parameters of the machine to assess clearances to electrical overhead installations. Only persons appointed by the responsible engineer may operate the machine	Administrative 3: Possible	4: High	18 (S)	
Operating and Maintaining	Noise			Safety	Struck by protruding object	Operating parameters of the machine should be taken into account during planning and mining layouts. Restricted areas to be demarcated properly in accordance with regulations. The responsible persons should take into account limitations and design parameters of the machine to assess clearances to electrical overhead installations. Only persons appointed by the responsible engineer may operate the machine	Administrative 3: Possible	4: High	18 (S)	
Operating and Maintaining	Pressure / Explosions			Safety	Collide with overhead installation, when training with a raised boom, resulting into structural failure	COP Occupational Health Care programme for Noise Noise induced hearing loss programme, Enforce the use of ear protection, Annual medical examinations	Administrative 3: Possible	4: High	18 (S)	
Operating and Maintaining	Noise			Health	Noise induced hearing loss	Isolation and lock out procedures, Ensure Zero Energy Principles are applied, QA Aard Mining Equipment during assembly, Ensure only competent artisans work on the machines, Enquire test certificates for 3rd party repairs, Avoid the use of Pirate parts	Administrative 2: Unlikely	4: High	14 (S)	
Operating and Maintaining				Safety	Hydraulic hose or fitting failure - struck by hydraulic fluid under pressure	Administrative 3: Possible	3: Mod	13 (S)		

Activity / Process	Emerging hazards List the processes, activity, equipment or component	Way to look for hazards - A source of potential harm to people, facilities or the environment or the community	Magnitude of Hazard (Quantity)	Release Mechanism of Hazard/Energy	Maximum Reasonable Consequences (S,H,E)	Unwanted event An incident or situation which occurs in a particular place during a particular interval of time. Events involve releases or manifestations of or exposures to the hazard(s).	Controls		Comment / additional controls by the Risk Owner or for implementation / Enhancement of existing controls (Please detail)
							Hierarchy of control	Likelihood of consequence	
Operating and Maintaining	Pressure / Explosions	Hydraulic pressure, Pneumatic	Loss of containment, Fatigue, Vibration	Safety	Struck by debris following pressure system failure	Control or barrier defined as 'any thing used to control, prevent or impede energy flows or the loss of control of a hazard'. It is essential to consider control or barriers in terms of their order of greatest effectiveness - Hierarchy of Control	Administrative	3: Possible	3: Mod
Operating and Maintaining	Pressure / Explosions		Blocked in, Plate parts, Incorrect installation by 3rd parties, exceeding limitation, Loss of support during maintenance (replacement of cylinders, hoses, etc.)	Safety	Struck by machine section collapsing if vacuum or pressure failure	Isolation and lock out procedures. Enforce zero Energy Principles are applied. On AARD Mining Equipment during assembly, Ensure only competent artisans work on the machines. Enquire test certificates for 3rd party repairs. Avoid the use of parts during maintenance and repairs are maintained until the operational tests has been performed. Lock pins and bars should be used where necessary. Zero energy principles to be applied during maintenance. Apply Isolation and lock out procedures. Barricade the maintenance activity area to prevent unauthorized entry during maintenance. After maintenance tests is to be conducted under direct supervision of a competent and appointed person	Administrative	3: Possible	3: Mod
Operating and Maintaining	Psychological	Substance abuse by the operator	External / Internal influences, Relationships, Social Environment	Health	Restricted and impaired actions	EAP (Employee Assistance Program). Random searching & substance testing. Apply zero tolerance. All operators tested at start of shift	Administrative	3: Possible	4: High
Operating and Maintaining	Psychological	Substance abuse by the operator	External / Internal influences, Relationships, Social Environment	Health	Misjudgment and person crushed against objects and struck by boom / hammer section	EAP (Employee Assistance Program). Random searching & substance testing. Apply zero tolerance. All operators tested at start of shift. Ensure all bystanders are removed prior to operations.	Administrative	3: Possible	4: High
Operating and Maintaining	Psychological	Substance abuse by the operator	External / Internal influences, Relationships, Social Environment	Health	Failure to recognize unsafe operations	EAP (Employee Assistance Program). Random searching & substance testing. Apply zero tolerance. All operators tested at start of shift	Administrative	3: Possible	4: High
Operating and Maintaining	Psychological	Psychological stressors (Shift work and long hours, Noise, etc.)	Abnormal production pressure, Loss of skilled personnel	Health	Exposure to combined 'temporal' stressors in addition to physical stressors - Significant effects on physiological measures (including blood pressure)	EAP (Employee Assistance Program). Shift roster, Rest cycles	Administrative	4: Likely	2: Min
Operating and Maintaining	Thermal	> 27.5 degrees Celsius WB, > 37 degrees Celsius DB	Air Quality, Virgin rock temperature, Machine operations, Stagnant water	Safety	Heat related illnesses	COP Occupational Health Care Programme for Thermal stress. Ventilation standards	Administrative	3: Possible	3: Mod
Operating and Maintaining	Vibration	> 2.8 Hertz, whole body vibration	Manual operation of machinery	Health	MSD (Muscular Skeleton disorder)	Medical treatment, Clinic on site during the week, Kidney belts, Design of the hydraulic operated Boom / hammer section fitted to the machine	Administrative	2: Unlikely	2: Min
Operating and Maintaining	Vibration	> 2.8 Hertz, whole body vibration	Operating of Scaler, 1 or 4 Wheeler machine, Loosse mountings	Health	Long term, High intensity whole body vibration - Disorders of the lumbar spine and connected nervous system	Medical treatment, Clinic on site during the week, Kidney belts, Design of the hydraulic operated Boom / hammer section fitted to the machine, Medical Surveillance	Administrative	2: Unlikely	5: Lit
Operating and Maintaining	Other	Driver with defective vision	Bypassing examination system, Inadequate screening of operators	Safety	Failure to recognize unsafe operations	Physical capability programme to flag these persons automatically for replacement during examinations. Adhere to COP Minimum standards for fitness to work at a Mine requirements. Exclusion - Visual field less than 50/70	Administrative	3: Possible	3: Mod
Operating and Maintaining	Other	Driver with defective vision	Bypassing examination system, Inadequate screening of operators	Safety	Failure to judgment of distance and person crushed against objects or fit side	Physical capability programme to flag these persons automatically for replacement during examinations. Adhere to COP Minimum standards for fitness to work at a Mine requirements. Exclusion - Visual field less than 50/70	Administrative	3: Possible	4: High
Operating and Maintaining	Other	Driver with defective vision	Bypassing examination system, Inadequate screening of operators	Safety	Misinterpreting controls and indicators	Physical capability programme to flag these persons automatically for replacement during examinations. Adhere to COP Minimum standards for fitness to work at a Mine requirements. Exclusion - Visual field less than 50/70	Administrative	3: Possible	4: High
Operating and Maintaining	Other	Operator drowsiness	Bypassing examination system, Inadequate screening of operators	Safety	Lack of concentration - incorrect or delayed actions	Operators should not exceed normal work hours and receive official breaks. Adhere to COP Minimum standards for fitness to work at a Mine requirements. Exclusion - Visual field less than 50/70	Administrative	3: Possible	3: Mod
Operating and Maintaining	Other	Operator drowsiness	Bypassing examination system, Inadequate screening of operators	Safety	Operator faint and trapped inside cabin, blackouts	Medical examination for operators to include all requirements of the COP Minimum Standards for fitness to work at a Mine. Epilepsy / Neurological state affecting level of consciousness, Diabetes, Cardiovascular (e.g. ischemic heart disease.)	Administrative	3: Possible	3: Mod
Operating and Maintaining	Other	Operator drowsiness	Bypassing examination system, Inadequate screening of operators	Safety	- loss control over body function	Medical examination for operators to include all requirements of the COP Minimum Standards for fitness to work at a Mine. Ensure exclusion rules are applied where applicable to equipment operator categories	Administrative	3: Possible	4: High

Activity / Process	Emerging hazards		Release Mechanism of Hazard/Energy	Maximum Reasonable Consequences (S.H.E)	Unwanted event	Controls	Hierarchy of control	Likelihood of occurrence	Consequence rating	Comments/ additional controls by the Risk Owner or for implementation / Enhancement of existing controls (Please detail)
	Magnitude of Hazard (Quantity)	Way to look for hazards - A source of potential harm to people, facilities, environment or the community								
Operating and Maintaining	Other	Undisclosed Medical condition	Epilepsy, Neurological state , Diabetes, Ischemic heart disease, Cluster phobia	Safety	Operator faint and trapped inside cabin	Medical examination for operators to include all requirements of the COP Minimum Standards for fitness to work at a Mine, Correlate control and mitigating measures from the TMM COP with the above mentioned COP.	Administrative	3: Possible	3: Mod	13 (S)
Operating and Maintaining	Other	Undisclosed Medical condition	Epilepsy, Neurological state , Diabetes, Ischemic heart disease, Cluster phobia	Safety	Misinterpretation of controls - collisions	Medical examination for operators to include all requirements of the CCP Minimum Standards for fitness to work at a Mine, Correlate control and mitigating measures from the TMM COP with the above mentioned COP.	Administrative	3: Possible	4: High	18 (S)

Mine Health and Safety Act, Act 29 of 1996, as Amended				
Section or Regulation	Description	Impact / Requirements for Compliance	Existing COP's, SWP's, SOP's, Std's, etc.	Recommendations
Sect 21 (4) (a) & (b) Suppliers	Duties of Manufacturers and Suppliers	(4) Every person who manufactures, imports or supplies any hazardous substance for use at a mine must- • Ensure, as far as reasonably practicable, that the substance is safe and without risk to health and safety when used, handled, processed, stored or transported at a mine in accordance with the information provided in terms of paragraph (b);  • Provide adequate information about- - the use of the substance; - the risks to health and safety associated with the substance; - any restriction or control on the use, transport and storage of the substance, including but not limited to exposure limits; - the safety precautions to ensure that the substance is without risk to health or safety; - the procedure to be followed in the case of an accident involving excessive exposure to the substance, or any other emergency involving the substance; and - the disposal of used containers in which the substance has been stored and any waste involving the substance; and  • Ensure that the information provided in terms of paragraph (b) complies with the provisions of the Hazardous Substances Act, 1973 (Act 15 of 1973),		
9.1 (2)	Early Warning Systems	Where the risk assessment at the mine indicates a significant risk of a fire and/or explosion and/or toxic release that could lead to an irrespirable atmosphere or an atmosphere immediately dangerous to life or health, the employer must provide an early warning system or systems at all working places.		
9.2 (1)	Occupational exposure to health hazards	The employer must ensure that the occupational exposure to health hazards of employees is maintained below the limits set out in Schedule 22(9)(2) (a) and (b).		
9.2 (2)	System of Occupational Hygiene Measurements	The employer must establish and maintain a system of occupational hygiene measurements, as contemplated in section 12, of all working places where the following hazard limits prevail: (a) airborne pollutants - particulates > 1/10 of the occupational exposure limit; - gases and vapours > 1/2 of the occupational exposure limit; (b) thermal stress - heat >25,0°C wet bulb and/or >32,0°C dry bulb and/or >32,0°C mean radiant temperature;- cold <10°C equivalent chill temperature; and (c) noise - >82dB(A eq. 8h.		
9.2(9)	Illumination of Working Places	The employer must ensure that the illumination at all working places is sufficient to enable employees, who have conformed to the requirements of the vision tests conducted in terms of the Guideline for the Minimum Standards of Fitness to Perform work at a Mine, to perform their work safely.		
16.1 (1)	Report to Employer Relating to Explosions, Fires and Flooding	The employer must ensure that a competent person reports to the employer, at appropriate intervals determined in accordance with the mine's risk assessment, on the adequacy of escape and rescue procedures at the mine relating to explosions, fires and flooding.		

Mine Health and Safety Act; Act 29 of 1996, as Amended				
Section or Regulation	Description	Impact / Requirements for Compliance	Existing COP's, SWP's, SOP's, Std's, etc.	Recommendations
Regulation 8.8 General Machinery Regulations	<p>(1) The employer must take reasonably practicable measures to prevent persons from being injured as a result of them, the clothes being worn by them or any equipment being held by them coming into contact with or being drawn into any moving part of any machine.</p> <p>(2) The employer must take reasonably practicable measures to prevent persons from being injured because of any machinery failing as a result of -</p> <ul style="list-style-type: none"> <li>(a) incorrect design;</li> <li>(b) incorrect installation;</li> <li>(c) poor maintenance; or</li> <li>(d) incorrect use or non-compliance with proper operating or safety procedures.</li> </ul> <p>(3) The measures to be taken by the employer in terms of regulation 1 must include measures to ensure that –</p> <ul style="list-style-type: none"> <li>(a) only persons authorized by the employer to do so, start operate and maintain any machine where such starting, operation or maintenance may pose a significant risk to any person;</li> <li>(b) where the moving of machinery may pose a significant risk to any person, such machinery is only moved under the constant supervision of a competent person who is fully aware of the risks attached to such moving of the machinery;</li> <li>(c) only persons authorised by the employer to do so enter any area where machinery is operated, where such operation may pose a significant risk to any person;</li> <li>(d) machinery is only operated if all installed safety devices are operational and functional;</li> <li>(g) here there could be a significant risk to any person working on any machinery due to the release from such machine of any mechanical, electrical, hydraulic, chemical or other source of energy, a written lockout procedure is prepared and implemented to ensure that such source of energy is effectively locked out and de-energised before any person works on such machinery;</li> <li>(i) means are provided, on or in close proximity to any machine, to immediately remove the source of power to that machine in case of an emergency;</li> </ul> <p>(k) starting devices are so arranged that no accidental starting of machinery can take place; and</p> <ul style="list-style-type: none"> <li>(l) all electrical, pneumatic and hydraulic portable equipment are operated and maintained in a safe working order;</li> </ul> <p>(4) The measures to be taken by the employer to prevent any person from coming into contact with any moving part of machinery or any equipment attached thereto, must include –</p> <ul style="list-style-type: none"> <li>(b) failsafe electric or electronic barriers interlocked with the machinery in such a way that the machinery would be stopped before persons come into contact with moving machinery or parts thereof; or</li> <li>(c) effective barriers at a safe distance away from any machinery.</li> </ul> <p>5.(b) all services, maintenance and repairs to diesel-powered equipment are performed by a competent person;</p> <p>6. The employer must take reasonably practicable measures to ensure that every mobile diesel engine powered unit, when not in use, is kept at a location that is sufficiently ventilated to prevent a build up of diesel fumes in the air at that location sufficient to cause a significant risk when starting up that engine.</p>			
8.10.1 Collisions between trackless mobile machines and pedestrians	The employer must take reasonably practicable measures to ensure that pedestrian 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 collision, such measures must include at least the following: (Read with the automatic detection and retardant systems in sub sections)			

Mine Health and Safety Act; Act 29 of 1996, as Amended				
Section or Regulation	Description	Impact / Requirements for Compliance	Existing COP's, SWP's, SOP's, Std's, etc.	Recommendations
8.10.2	Collisions between diesel powered trackless mobile machines	The employer must take reasonably practicable measures to ensure that persons are prevented from being injured as a result of collision between diesel powered trackless mobile machines. (Read with sub-sections)		
8.10.3	Trackless Mobile machines running uncontrolled	The employer must take reasonably practicable measures to prevent trackless mobile machines running uncontrolled.		
8.10.4	Overtaking of trackless mobile machine	The employer must take reasonably practicable measures to ensure that persons are prevented from being injured as a result of object falling onto operators and/or passengers of trackless mobile machines. Trackless mobile machines must be fitted with falling object protection structures to protect operators and passengers from falling objects if required in terms of the mine's risk assessment.		
8.10.5	Object falling onto operators and/or passengers of trackless mobile machines	The employer must take reasonably practicable measures to ensure that persons are prevented from being injured as a result of overturning of any trackless mobile machines. Roll over protection structures must be fitted on trackless mobile machines if required in terms of the mine's risk assessment.		
8.10.7	Brake systems	The employer must take reasonably practicable measures to ensure that persons are prevented from being injured as a result of brake failure. Such measure must include: (Read with sub sections)		
8.10.17	Operating procedures	The employer must take reasonably practicable measures to ensure that procedures are prepared and implemented for the safe operation of trackless mobile machines.		
8.10.18	Maintenance standards and procedures	The employer must take reasonably practicable measures to ensure that procedures are prepared and implemented for maintaining trackless mobile machines in a safe condition.		

<b>Initials and Surname</b>	<b>Designation</b>	<b>Qualifications</b>	<b>Experience</b>
AC v/d Vyver (Snr)	SheRisk (facilitator)	N. Dip Safety Management  Specialists Member at Institute of Risk Management: UK	11 Years Mining Production  23 Years Risk Management Consultancy
AC. v/d Vyver (Jnr)	SheRisk (Human Error and Risk Assessor)	B.Pub (Human Resource Management)  Human behavioural specialist  SAMTRAC  Certified Member at Institute of Risk Management: UK	8 Years Risk Management Consultancy & Training

Hazard Aspect / Risk Source	Definition
Biological	Potential for positive or negative impacts resulting from interaction of activities with biological agents. This could be harm by exposure to biological hazards, flora and fauna including insect stings, bites, bacteria and other disease agents, viruses and natural poisons or environmental harm to biodiversity.
Chemical	Potential for harm by chemicals. Includes acids, alkalis, organic substances (eg. gases, fuels, lubes, degreasers, solvents, paints), ozone depleting substances etc.
Climatic/ Natural Events	Potential for harm by exposure to extreme natural , environmental or climatic sources and events (incl. lightning, high winds, flooding)
Confined Spaces	Potential for harm resulting from suffocation due to working in/been trapped in a confined space.
Dust / Inhalable particulates	Potential for harm by exposure to fine dry particles of matter in the air. Dusts, mists, vapours and aerosols (coal dust, silica dust or environmental nuisance/community complaints)
Electrical	Potential for harm to people, equipment/assets or the environment by exposure to electrical sources
Ergonomics	Potential for exposure to physical actions or forces, including poor design, thus presenting the potential for harm associated with exertion, excessive, unnatural or repetitive movement, poor posture or other undesired physical stress on the human body
Explosives	Potential for harm by exposure to explosive materials (e.g. unexploded detonators, tie down lines etc.)
External Threats	Potential for harm resulting from an external event outside of the operations direct control (e.g. legislation, government actions, community lobby groups, etc.)
Fire	Potential for harm by exposure to a burning mass of material (e.g. building fires, spontaneous combustion)
Gravitational (Objects)	Potential for harm by exposure to falling objects, unexpected movement (ground, slope, structures) due to uncontrolled gravitational forces
Gravitational (People)	Potential for harm to people caused by their being subject to falling, unexpected movement or in any other way resulting from their being exposed to uncontrolled gravitational forces (incl. slips, trips, falls)
Land	Potential harm on the naturally occurring environment due to the use or management of land resulting from pollution, clearance or any other degradation
Lighting	Potential for harm resulting from excess light or inadequate lighting in the workplace
Mechanical (Fixed)	Potential for harm by exposure to interaction with sources of fixed mechanical energy (including those powered be electrical, hydraulic, pneumatic, combustion etc)
Mechanical (Mobile)	Potential for harm by exposure to interaction with sources of mobile (self propelled) mechanical energy (including those powered be electrical, hydraulic, pneumatic, combustion etc)
Magnetic	Potential for harm to people, equipment/assets or the environment by exposure to magnetic sources (incl. handling metal objects in strong magnetic fields)
Noise	Potential for harm by exposure to sudden or prolonged exposure to excessive noise or community complaints
Personal / Behaviour	Potential for harm associated with intentional undesired behavioural actions, stresses or stressors
Pressure / Explosions	Potential for harm by exposure to sudden release of pressure from a specific source (incl. pressure waves from explosions, pressurised systems, cylinders, springs, chains, flying bits, or community complaints associated with air blast overpressure etc)
Psychological	Potential for harm associated with stressors from situations, conditions or events that could create negative emotional, cognitive or behavioural outcomes
Radiation	Potential for harm by exposure to radiation waves whether natural or manufactured sources (characterised as either ionising or non-ionising sources)
Social/ Cultural	Potential for positive or negative impacts resulting from interaction of business' activities with social or cultural expectations includes social license to operate
Thermal	Potential for harm by exposure to or variations in temperature (hot or cold) but excludes anything that is on fire which has a separate category
Vibration	Potential for harm resulting from prolonged exposures to excessive vibration or blast vibration
Waste	Potential for harm caused by the inappropriate use of resources, inadequate management or disposal of waste material (includes pollution and Green House Gases)
Water	Potential for harm caused by the inappropriate use of water resources or inappropriate management or disposal of water
Other	Potential for harm by exposure to other hazard/aspects e.g. friction, bio-chemical

<b>Likelihood</b>	<b>Description</b>
<b>5 Almost Certain</b>	Considering the presence of the hazard and the exposure to that hazard (number of people and frequency of the tasks exposing those people), as also the status of existing controls. History of previous events should not be the norm or trend to project into future events, new controls will have an impact or change, also "never happen" does not mean "will never happen".
<b>4 Likely</b>	the unwanted event is almost certain to happen within the life cycle of the operation. In the case of repetitive/ frequent tasks the unwanted event has or will occur in order of one or more times per year. In terms of major events, as also in the case of long term health, environmental or social impacts, it may happen only once in the life cycle of the operation.
<b>3 Possible</b>	there is a high probability that the unwanted event will occur within the life cycle of the operation. In the case of repetitive/ frequent tasks the unwanted event has occurred or is likely to occur in order of less than once per year. In terms of major events, as also in the case of long term health, environmental or social impacts, it might happen once in the life cycle of the operation.
<b>2 Unlikely</b>	it is possible that the unwanted event can occur within the life cycle of the operation. In the case of repetitive/ frequent tasks the unwanted event has occurred or is likely to occur in order of once every 5-10 years. In terms of major events, as also in the case of long term health, environmental or social impacts, it may possibly happen once in the life cycle of the operation.
<b>1 Rare</b>	there is a low probability for the unwanted event to occur within the life cycle of the operation. In the case of repetitive/ frequent tasks the unwanted event has occurred some time or is likely to occur not more than once every 10-20 years. In terms of major events, as also in the case of long term health, environmental or social impacts, there is a low probability for the event to happen in the life cycle of the operation.
	there is a very low probability for the unwanted event to occur within the life cycle of the operation. In the case of repetitive/ frequent tasks there are no records of the event occurring or it is highly unlikely that it will occur within the next 20 years. In terms of major events, as also in the case of long term health, environmental or social impacts, there is a very low probability for the event to ever happen.

Consequence Level						
	(consider the maximum reasonable potential consequence of the event taken with controls in place)					
Impact Type (Additional 'Impact Types' may exist for an event; identify & rate accordingly)	1 Minor	2 Low	3 Medium	4 High	5 Major	
<b>Harm to People-Safety (H)</b>	First aid	Medical treatment	Lost time	Permanent disability or single fatality	Numerous permanent disabilities or multiple fatalities	
<b>Harm to People- Occupational Health</b>	Exposure to health hazard resulting in minor discomfort	Exposure to health hazards/ agents (over the OEL) resulting in reversible impact on health (with lost time) or permanent change with no disability or loss of quality of life	Exposure to health hazards/ agents (significantly over the OEL) resulting in irreversible impact on health with loss of quality of life (permanent disability) or single fatality	Exposure to health hazards/ agents (significantly over the OEL) resulting in irreversible impact on health with loss of quality of life of a numerous group/ population or multiple fatalities		
<b>(E)</b>  <b>Environmental Impact</b>	Lasting days or less; limited to small area (metres); receptor of low significance/ sensitivity (industrial area)	Lasting weeks; reduced area (hundreds of metres); no environmentally sensitive species/ habitat	Lasting years; impact on an extended area (kilometres); area with some environmental sensitivity (scarce/ valuable environment).	Lasting years; impact on sub-basin; environmentally sensitive environment/ receptor (endangered species/ habitats).	Permanent impact; affects a whole basin or region; highly sensitive environment (endangered species, wetlands, protected habitats)	
<b>(C)</b>  <b>Social / Community Impact</b>	Minor disturbance of culture/ social structures	Some impacts on local population, mostly repairable. Single stakeholder complaint in reporting period	On going social issues. Isolated complaints from community members/ stakeholders	Organized community protests threatening continuity of operations	Major widespread social impacts. Community reaction affecting business continuity. "License to operate" under jeopardy	
<b>(L&amp;R)</b>  <b>Legal &amp; Regulatory</b>	Technical non-compliance. No warning received; no regulatory reporting required	Breach of regulatory requirements; report/involvement of authority. Attracts administrative fine	Minor breach of law; report/investigation by authority. Attracts compensation/ penalties/ enforcement action	Breach of the law; may attract criminal prosecution of Operating Co. and/or of Directors/ Mgrs. And penalties/ enforcement action. Individual licence temporarily revoked	Significant breach of the law. Individual or Class action law suits, criminal prosecution of Co., Directors/ Mgrs. Suits against parent Co.; permit to operate substantially modified or withdrawn	
<b>(M)</b>  <b>Material Losses/ Damage/ Business Interruption</b>	< 0.01 % of Annual Revenue/ Total Assets	0.01 - 0.1 % of Annual Revenue/ Total Assets	0.1 – 1.0 % of Annual Revenue/ Total Assets	1 - 5 % of Annual Revenue/ Total Assets	> 5 % of Annual Revenue/ Total Assets	
<b>(R)</b>  <b>Impact on Reputation</b>	Minor impact; awareness/ concern from specific individuals	Limited impact; concern/ complaints from certain groups/ organizations (e.g. NGOs)	adverse publicity localised within neighbouring communities	Suspected reputational damage; local/ regional public concern and reactions	Non-existent/reputational damage; national/ international public attention and consequences.	

Likelihood	Consequence	1 Minor	2 Low	3 Medium	4 High	5 Major
5 Almost certain	Medium -11	High -16	High -20	Extremely high -23	Extremely high -25	
4 Likely	Medium -7	Medium -12	High -17	Extremely high -21	Extremely high -24	
3 Possible	Low -4	Medium -8	High -13	High -18	Extremely high -22	
2 Unlikely	Low -2	Low -5	Medium -9	High -14	High -19	
1 Rare	Low -1	Low -3	Medium -6	Medium -10	High -15	

**Short CV: AC vd Vyver (SIRM:UK)**

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As lecturer at the University of Pretoria for BSc Mining Engineering the past four years Albert has distinguished himself as a leading specialist in Safety Management, backed with a mining career of 34 years he has built a multinational relationship with clients.

He developed an imitable approach to safety management when he started his own company, SheRisk in 1997, focusing on risk awareness, risk evaluation and risk assessments. Utilizing his production experience he developed a practical approach to deal with human error and behaviour in the workplace. The company has grown today to include human resource consultancy, selection process assessments, and emotional intelligence development and very soon will undertake the approach of psychometric testing for safety.

Albert has undertaken numerous Greenfield and Brownfield project risk assessments, bankable feasibility study assessments, normal run of the mill and product supply risk assessments, design engineering assessments, and lately Major Hazard Management assessments across Africa and South America. Consultancy for SHE strategies, which include safety leadership development, to Board members, executives, middle management and facilitation of workshops enhanced the service he provides.

A handwritten signature in black ink, appearing to read "Albert C. vd Vyver".

**Aug-16**