Department of Mineral Resources

PROXIMITY DETECTION AND
ARP 0108

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Acting Director Mine Safety

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Trackless Mobile Machine fatalities and injuries
Proximity Detection Devices

1. SIMRAC Project 2000
2. Instruction 2006
3. Fatals and Injuries NOT decreasing - Mines show no improvement
4. Legislation promulgated 27 February 2015
5. Working group between Employers, PDS Manufactures and Diesel engine suppliers
6. Proposal still awaiting Promulgation
1. Regulation 8.10.1
The employer must take reasonably practicable measures to ensure that persons are not 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: Applies to all mines that have a significant risk. Those requiring are electrical machines and underground diesel powered machines.

2. Regulation 8.10.1.1
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.
3. Regulation 8.10.1.1 cont
In the event where no action is taken to prevent a potential collision, further means must be provided to retard the trackless mobile machine to a safe speed where after the brakes of the trackless mobile machine must be automatically applied. The system on the trackless mobile machine must fail to safe without human intervention.

4 Regulation 8.10.1.2
All underground diesel powered trackless mobile machines must be provided with means to automatically detect the presence of any pedestrian within its vicinity and:

5 Regulation 8.10.1.2(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 must be warned of each other’s presence by means of an effective warning; and
6. Regulation 8.10.1.2(b) To be enforced later
in the event where no action is taken to prevent a potential collision, further means must 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 must be automatically applied. The system on the diesel powered trackless mobile machine must fail to safe without human intervention.
7. Regulation 8.10.2
The employer must take **reasonably practicable measures** to ensure that persons are not 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:

8. Regulation 8.10.2.1
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

9. Regulation 8.10.2.1(a)
upon detecting the presence of another diesel powered **trackless mobile machine**, the operators of both diesel powered **trackless mobile machines** must be warned of each other’s presence by means of an effective warning; and
10. Regulation 8.10.2.1(b) to be enforced later in the event where no action is taken to prevent a potential collision, further means must 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 must be automatically applied. The system on the diesel powered trackless mobile machine must fail to safe without human intervention.

Opencast or open pit where there is a reasonably practicable
Levels of Control

1. Site Requirements
2. Segregation Controls
3. Operating Procedures
4. Authority to Operate
5. Fitness to Operate
6. Operating Compliance
7. Operator Awareness
8. Advisory Controls
9. Intervention Controls

Collision Avoidance
- Takes control from the operator

Proximity Awareness
- Alerts the operator

Proximity Detection
- Advises the operator

Collision Avoidance
- Takes control from the operator

Work Area Controls for all equipment that could reduce ‘significant risk’ and costs

Technology Controls to address ‘significant risk’
Regulation 8.10.1 and 8.10.2
Regulations to be promulgated

**TRACKLESS MOBILE MACHINERY**

Diesel trackless mobile machines and pedestrians as well as the collisions between diesel powered machines respectively will be enforced as per the schedule below.

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Risk</th>
<th>Control Level</th>
<th>Target Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>UG Diesel TMM manual machines</td>
<td>Significant Risk</td>
<td>Collision Avoidance</td>
<td>42 Month Grandfather period to overhaul and modify or replace existing machine – completed by end 2019</td>
</tr>
<tr>
<td>UG Diesel TMM OEM fitments</td>
<td>Significant Risk</td>
<td>Collision Avoidance</td>
<td>12 Months – end June 2017 all new equipment with significant risk to be purchased as OEM Level 9 ready</td>
</tr>
<tr>
<td>UG Diesel TMM</td>
<td>Significant Risk</td>
<td>Collision Avoidance</td>
<td>24 Months – full implementation by the end June 2018</td>
</tr>
<tr>
<td>Open Pit Diesel TMM</td>
<td>Significant Risk</td>
<td>Collision Avoidance</td>
<td>36 Months – full implementation by the end June 2019</td>
</tr>
<tr>
<td>Surface Equipment</td>
<td>Significant Risk</td>
<td>Collision Avoidance</td>
<td>36 Months – full implementation by the end June 2019</td>
</tr>
</tbody>
</table>
SECTION 21

(1) Any person who-
   (a) designs, manufactures, repairs, imports or supplies any article for use at a mine must ensure, as far as reasonably practicable-
      (i) That the article is safe and without risk to health and safety when used properly; and
      (ii) That it complies with all the requirements in terms of this Act.
Technology Development Process

End User Responsibilities

1. **Understand User Requirements**
2. **Understand Regulatory Requirements**
3. **Understand the market**

1. **Concept TRL 1-3**
   - 1. Understand User Requirements
   - 2. Understand Regulatory Requirements
   - 3. Understand the market

2. **Research TRL 4-5**
   - 1. Develop User Requirements
   - 2. Review alternatives
   - 3. Identify technologies
   - 4. Indicative Business Case
   - 5. Development Strategy and Schedule
   - 6. Development funding model
   - 7. Model the requirements
   - 8. Choose partner/s going forward

3. **Development TRL 6**
   - 1. Review User Requirements
   - 2. Model the requirements
   - 3. Define the specifications & deliverables
   - 4. Confirm the Test Protocols
   - 5. Update the Business Case

4. **Demonstration TRL 7**
   - 1. Confirm User Requirements, KPIs and Business Case
   - 2. Sign-off on exclusions
   - 3. Update the simulation model with actual data
   - 4. Confirm Deliverables and Test Protocols
   - 5. Update design and rebuild if necessary
   - 6. Review Design and Operational Risk Assessments
   - 7. Operator, Maintenance and Training Manuals
   - 8. Training

5. **Commercial TRL 8-9**
   - 1. Update User Requirements
   - 2. Sign-off on exclusions
   - 3. Develop Commercial Plan
   - 4. Develop Implementation Schedule
   - 5. Define Operating Procedures and Training
   - 6. Define Support Model

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**Red** – End User input required

- **Go/Redesign**
  - GO/Redevelop Date -
  - 1. Operational Risk Assessment
  - 2. Confirm Test Protocols
  - 3. Industrial Prototype (on multiple machines in a production test environment)

- **Go/Redevelop**
  - Go/Demo again
  - 1. Production Demonstration Test (on multiple machines in a production environment)
Guideline for the preparation of a ‘Technical information and Certification File’ in support of an application to the Department of Mineral Resources, for permission to conduct a trial on a mine with Proximity Detection Systems. (PDS)

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommended Documentation</th>
<th>Scope of the Documentation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction and Description of the Product</td>
<td>Introduction to the System and scope of application. Overview of the operating principles of the system</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Product development History</td>
<td>If already approved, list of current systems in operation on mines. List any ‘Incidents’ or accidents experienced, as well as details of the Inquiry findings</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Product Overview and Specifications</td>
<td>Description of the major components and their functions (in a connected state). This should include schematic drawings or block diagrams (Electrical and Mechanical),</td>
<td></td>
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<tr>
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<td>Comments</td>
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<tr>
<td>4</td>
<td>Applicable and Reference Standards and Regulations against which the product has been tested and approved</td>
<td>List applicable Standards: 1) Explosion protection. 1.1 SANS 60079-0 1.2 SANS 60079-11 2) Electromagnetic Compatibility in respect of a) RF emissions from the equipment and b) susceptibility of the equipment to RF emissions</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Certificates of compliance together with Safety Test Reports.</td>
<td>Formal safety test reports and Certification documents which would support compliance with the requirements of Section 4 above</td>
<td></td>
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<tr>
<td>6</td>
<td>Product Risk Assessment</td>
<td>SANS 31000:2009 – Risk Management Guidelines SANS 31010:2010 - Risk assessment techniques The FMECA format is recommended as appropriate for PDS systems 1) Risk Assessments for the components of the Product – individually for each of the major components identified in the ‘block diagram’ 2) Risk Assessment of the System in ‘Operating Mode’ (fully connected state) including all components of the Product.</td>
<td></td>
</tr>
<tr>
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</tr>
<tr>
<td>7</td>
<td>Field Trials and reports: (New or Modified systems)</td>
<td>Systematic field trials to demonstrate compliance with designed performance criteria. Formal report on results and technical reviews.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Competent User Manuals (as required by Section 21 of the MHSA Act)</td>
<td>This section will require Operator Manuals (Modules) that can be referenced by the User to compile Lesson Plans, and Codes of Practice for operating and maintaining the System.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Quality Control Systems</td>
<td>Auditable quality system such as ISO 9001 2008</td>
<td></td>
</tr>
</tbody>
</table>
1. **Equipment should be ICASA compliant.** (Test requirements and allowed power levels are listed in GOVERNMENT GAZETTE, 31 March 2011 No. 34172 Radio Frequency Spectrum Regulations) (The safety test ISO 60950 may be unnecessary in view of stringent IS requirements in SANS 60079. This could be discussed with Praneel Ruplal PRuplal@icasa.org.za or Albert Ntavhaedzi ANtavhaedzi@icasa.org.za at ICASA).

**Note 1:** In a case where ICASA compliance may be difficult in, for example, the low-frequency transmission bands, due to say, power level, an exemption for such underground equipment may be applied for together with a risk assessment for the application.

**Note 2:** Effective radiated power measurements are required to assess exclusion distances from electric initiators and safety-critical electronic equipment.
2. **Immunity levels of the equipment**: (Note that the equipment is safety-critical, hence high immunity levels are required). Test standards are listed in GOVERNMENT GAZETTE, 22 JANUARY 2010 No.32885

SANS 61000-4-2 Electrostatic immunity test 15kV air discharge & 8 kV contact discharge (Criterion B - self recovery).

SANS 61000-4-3 Radiated radio-frequency electromagnetic field immunity test. 80MHz - 6GHz 10V/m (Criterion A - full functionality).

SANS 61000-4-4 Electrical fast transient/burst immunity test: 4kV on the power supply port and on the control lines connected to mains power and 2 kV on/off, signal and data ports. (Criterion B - self recovery).

SANS 61000-4-5 Surge immunity test (applicable where mains powering is used) Line to line 2kV and line to earth 4kV (Criterion B self recovery).
SANS 61000-4-6 Immunity to conducted disturbances, induced by radio-frequency fields 150kHz-80MHz 10V (Criterion A - full functionality).
SANS 61000-4-9 Pulsed magnetic field immunity test 300A/m (Criterion A - full functionality)
SANS 61000-4-11 Voltage dips, short interruptions and voltage variations immunity tests (Applicable where power is mains derived)  
   a) voltage dips: 30 % voltage reduction during 10 ms;  
   b) voltage dips: 60 % voltage reduction during 100 ms;  
   c) voltage interruptions: > 95 % voltage reduction during 5 000 ms. (criterion B - self recovery).
ISO 7637-2:2011 Road vehicles -- Electrical disturbances from conduction and coupling -- Part 2: Electrical transient conduction along supply lines only. (This test may be applicable).
RSA TEST REQUIREMENTS FOR PROXIMITY DETECTION SYSTEMS FOR USE IN OR AT MINES

SANS 61000-4-6 Immunity to conducted disturbances, induced by radio-frequency fields 150kHz-80MHz 10V (Criterion A - full functionality).
SANS 61000-4-9 Pulsed magnetic field immunity test 300A/m (Criterion A - full functionality)
SANS 61000-4-11 Voltage dips, short interruptions and voltage variations immunity tests (Applicable where power is mains derived) a) voltage dips: 30 % voltage reduction during 10 ms; b) voltage dips: 60 % voltage reduction during 100 ms;c) voltage interruptions: > 95 % voltage reduction during 5 000 ms. (criterion B - self recovery).
ISO 7637-2:2011 Road vehicles -- Electrical disturbances from conduction and coupling -- Part 2: Electrical transient conduction along supply lines only. (This test may be applicable).
3. Emissions compliance at industrial levels specified in:
   - EN/ETS 301-489-1 Electromagnetic compatibility and Radio spectrum Matters (ERM); Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirement requires CISPR 22 radiated and conducted emissions (including DC equipment) and the IEC specs listed.

Other applicable tests may include:
   - SANS211 (CISPR-11) Industrial, Scientific and Medical (ISM) equipment, excluding I SANS 211 SANS 224 telecommunications equipment operating in the ISM bands mandated by ITU-R.
   - SANS 215 (CISPR-15) Electrical lighting and similar equipment.
4. Spectrum management at mines:
As incidences of interference between equipment from different suppliers has been noted and susceptibility to other transmitting systems is possible, the mine must
Maintain a spectrum register of transmission equipment, frequencies, modulation type and powers. (This information is to be used in the risk assessment for the new transmission equipment in the mine.)

Concluding remark: As there are relatively few suppliers of this type of proximity equipment it should be noted that tests listed above may be carried out speedily at local test facilities, thus complementing any existing tests for such equipment should not be a daunting task.
DEFINITIONS

Significant risk  Where there is the possibility of a fatality or injury

Risk assessment
Every employer must
(a) Identify the hazard to health or safety to which employees may be exposed while they are at work
(b) Identify the risk to health or safety to which employees may be exposed while they are at work
(c) Record the significant hazards identified and the risks assessed
(d) Make those records identified available for inspection by employees
RISK ASSESSMENT

(a) Eliminate any recorded risk.
(b) Control the risk at source
(c) Minimise the risk; and
(d) In so far as the risk remains-
   (i) provide personal protective equipment; and
   (ii) institute a program to monitor the risk to which the
    employees maybe exposed
ARP0108

SABS document- Document not published

Revised document will be displayed on the DMR Web site

Diesel engines regulatory requirements

Caplamps regulatory requirements
Ngiyabonga !

Thank You !

Dankie !