

Australian/New Zealand Standard™

Remote control systems for mining equipment

Part 3: Operation and maintenance for underground coal mining



AS/NZS 4240.3:2013

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Department of Natural Resources and Mines, QLD
Department of Trade and Investment, Regional Infrastructure and Services, NSW
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Part 3: Operation and maintenance for underground coal mining

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-023, Electrical Equipment in Mines and Quarries.

This Standard is based on NSW MDG 5002 C, *Guidelines for the use of remote controlled mining equipment in underground coal mines*, which was developed for the Mine Safety Operations Division of Trade and Investment NSW by a working group consisting of representatives from major underground coal mines operating remote control mining equipment together with equipment suppliers, maintenance personnel, CFMEU and regulators. NSW MDG 5002 C will be withdrawn on publication of this Standard.

The objective of this Standard is to provide mines with the information and requirements to assist in the management of risks associated with the use of remote control mining equipment in underground coal mines.

The term ‘informative’ has been used in this Standard to define the application of the appendix to which it applies. An ‘informative’ appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to Figures are deemed to be requirements of the Standard.

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STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
Remote control systems for mining equipment

Part 3: Operation and maintenance for underground coal mining

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard provides information and specifies requirements for the management of risks associated with remote control mining equipment in underground coal mines. It covers issues related to work system design, equipment operation and maintenance, personnel and the environment in which the equipment is operated.

NOTE: Technical requirements for the design of remote control equipment are given in AS/NZS 4240.1, *Remote control systems for mining equipment—Part 1: Design, construction, testing, installation and commissioning*.

This Standard applies to the following equipment:

- (a) Continuous miners (including roadheaders, bolter miners, sump miners and the like).
- (b) Shearers.
- (c) Mobile roof supports [breaker line supports (BLS)].
- (d) Mobile roof bolters.
- (e) Continuous haulage systems.
- (f) Breaker feeders.
- (g) Load haul dump vehicles (LHDs).
- (h) Shearer carriers.
- (i) Shuttle cars.
- (j) Longwall pump station movers.

The Standard covers the use of the equipment throughout its life cycle, including arrival at the mine, transport underground, installation, commission, operation, maintenance and repair, and transport from the mine. It also encompasses both on board and off board modes of operation.

This Standard does not apply to the following equipment; however, it may be used to assist in the management of risks associated with these types of equipment:

- (i) Cranes.
- (ii) Shaft and drift winders.
- (iii) Special purpose equipment.
- (iv) Fixed conveyor systems.
- (v) Automatic vehicle guidance systems.
- (vi) SCADA and remote stop/start stations, e.g. remote closing of high voltage circuit breakers.
- (vii) Longwall roof support.

1.2 REFERENCED AND RELATED DOCUMENTS

1.2.1 Referenced documents

The following documents are referred to in this Standard:

AS

4024 Safety of machinery (series)

62061 Safety of machinery—Functional safety of safety-related electrical, electronic and programmable electronic control systems

AS/NZS

4240 Remote control systems for mining equipment (series)

4871 Electrical equipment for mines and quarries (series)

61508 Functional safety of electrical/electronic/programmable electronic safety-related systems (series)

AS/NZS ISO

31000 Risk management—principle and guidelines

Mine safety publications

NSW MDG 1010 Risk management handbook

NSW MDG 1014 Guide to reviewing a risk assessment of mine equipment and operations

NSW MDG 5002 Guidelines for the use of remote controlled mining equipment (series)

NSW MDG 5004 A study of the risky positioning behaviour of operators of remote control mining equipment

1.2.2 Related documents

Further information can be found in the following documents:

AS/NZS

2290 Electrical equipment for coal mines—Introduction and maintenance

2290.1 Part 1: For hazardous areas

Mine safety publications

NSW MDG 5001 Guidelines for the design of remote control systems for mining equipment

NSW MDG 15 Guideline for mobile and transportable equipment for use in mines

QLD Recognized Standard 01 Underground electrical equipment and electrical installations

QLD Recognized Standard 02 Control of risk management practices

QLD Recognized Standard 11 Training in coal mines

Mine safety management plan workbook

Minerals industry safety handbook—July 2002

Industry safety alerts, bulletins, incidents and recognized industry stakeholders information

Applicable codes of practice developed by regulators or nominated by legislation

1.3 DEFINITIONS AND ABBREVIATIONS

For the purposes of this Standard, the following definitions apply.

1.3.1 AFC

Armoured face conveyor. A steel conveyor system used on longwall faces.

1.3.2 Breaker feeder

A mobile piece of mining equipment that breaks large lumps of material into smaller pieces and discharges them onto the boot end of a conveyor belt.

1.3.3 Breaker line support (BLS)

A mobile electro-hydraulic roof support used for the temporary support of the roof.

1.3.4 Competency

Ability to apply appropriate skills and knowledge for the effective and efficient completion of a job or task in a variety of situations.

1.3.5 Competent person

A person who can demonstrate a combination of knowledge and skills to effectively, efficiently and safely carry out activities related to the operation or maintenance of remote control machinery/equipment as covered by this Standard.

1.3.6 Continuous miner (CM)

A piece of mobile equipment designed to cut and load coal or stone. This includes continuous miners, bolter miners and roadheaders.

1.3.7 Controlled work area

An area, defined by a site-specific risk assessment, that trained persons can enter to work and operate the machine. See figures in Appendix A for illustrations of controlled work areas in a variety of types of machines.

1.3.8 Cut-through or crosscut

A roadway driven perpendicular to panel advance designed to link headings and form pillars (refer to 1.3.14 below).

1.3.9 Development

Any combination of shafts, drives, crosscuts, inclines and declines by which an underground mining operation is opened up.

1.3.10 EEMP

Electrical engineering management/control plan.

1.3.11 Face

A working place where coal is being mined or proposed to be mined.

1.3.12 FFP

Fit for purpose or intended use.

1.3.13 Flit or flitting

To move/tram mobile face equipment from one place to another.

1.3.14 Heading

A roadway driven in the direction of panel advance.

1.3.15 ITP

Inspection and test plan.

1.3.16 JSA

Job safety analysis.

1.3.17 Load haul dump (LHD)

A piece of underground mobile equipment used to load, haul and relocate materials.

1.3.18 MEMP

Mechanical engineering management/control plan.

1.3.19 Monitor

To check, supervise, observe critically or measure the progress of an activity, action or system on a regular basis in order to identify change from the performance level required or expected.

1.3.20 No entry zone

An area, defined by a site-specific risk assessment, that persons cannot enter or stay in without full isolation, e.g. on top of a continuous miner or in the conveyor. See figures in Appendix A for illustrations of no entry zones in a variety of types of machines.

1.3.21 No standing zone

An area, defined by a site-specific risk assessment, that persons cannot enter or stand in without the appropriate controls in place. See figures in Appendix A for illustrations of no standing zones in a variety of types of machines.

1.3.22 OEM

Original equipment manufacturer.

1.3.23 Plant

Includes any machinery, equipment or appliance, container, implement or tool, and any component of any of these things, and anything fitted or connected to any of these things.

1.3.24 Platform

A raised structure, purpose built to allow work to be carried out in a safe manner, e.g. on a bolter miner or operating areas on multi bolters.

1.3.25 PPE

Personal protective equipment.

1.3.26 Proximity detection

An engineering solution to detect workers around a piece of equipment and to alert of imminent danger by alarming or controlled intervention.

1.3.27 Remote control

The ability to control a mobile machine by an operator utilizing transmitters, transceivers or directly connected pendants and excluding machine mounted controls or ancillary equipment controls. Pendants may transmit signals via electrical, hydraulic, pneumatic or other energy sources.

1.3.28 Residual risk

Remaining potential for harm to persons, property or the environment following all possible efforts to reduce predictable hazards.

NOTE: Risks such as being caught in/struck by the cutting head of a continuous miner or caught in pinch points between an LHD unit and the place in which it is driven are examples of this type of risk.

1.3.29 Rib

The side of any roadway in an underground mine.

1.3.30 Safety-related circuits

A circuit whose failure can cause an immediate or latent increase in risk.

1.3.31 Shuttle car

An item of electrically powered mobile equipment designed to transport coal from the miner to the conveyor belt.

1.3.32 SIL

Safety integrity level.

1.3.33 SOP

Standard or safe operating procedure.

1.3.34 TRS

Temporary roof support.

1.3.35 Unplanned movement

Unintended activation or movement of remote control machines or equipment. This may be due to equipment failure or other external influences, e.g. human error.

1.3.36 Visitor

A person who does not perform work but is within the operating area of the remote control system.

1.3.37 WHSMS

Work health and safety management system.

1.3.38 Worker

This includes persons working on site, management, maintainers, equipment operators, supervisors, contractors, suppliers, consultants and authorized officers.

1.4 RISK ASSESSMENT

Adherence to this Standard does not itself assure compliance with the general duty of care.

Mine operators deviating from this Standard should document a risk assessment supporting the alternative arrangements and demonstrate that there is no increase in safety risk.

Where mining operations require remote control machines to operate coupled with other mining equipment (e.g. longwall faces), this equipment shall be considered in any risk assessment associated with the remote control machine.

SECTION 2 WORK HEALTH SAFETY MANAGEMENT SYSTEM

2.1 GENERAL

Management systems for the use of remote control mining equipment shall be integrated with a Work Health Safety Management System (WHSMS) and be based on a risk management approach to safety.

Systems and procedures for each of the planning, management and operational steps identified in this Standard shall, where appropriate, be developed in consultation with a cross-section of affected workers and OEMs. These should be considered when developing hazard controls and safe systems of work for remote control mining equipment operations.

Procedures for monitoring and evaluating the entire remote control mining equipment process and environment shall be developed as an initial part of developing safe work practices and procedures. That is, no system or procedure is complete without a monitoring, evaluation and review component. For more detail refer to Clause 2.4.

Safe work systems for the use and maintenance of remote control mining equipment should be determined by a risk management approach. All hazards associated with the use and maintenance of remote control mining equipment should be identified, assessed and eliminated, or adequately controlled using the hierarchy of controls (Refer to Figure 1).

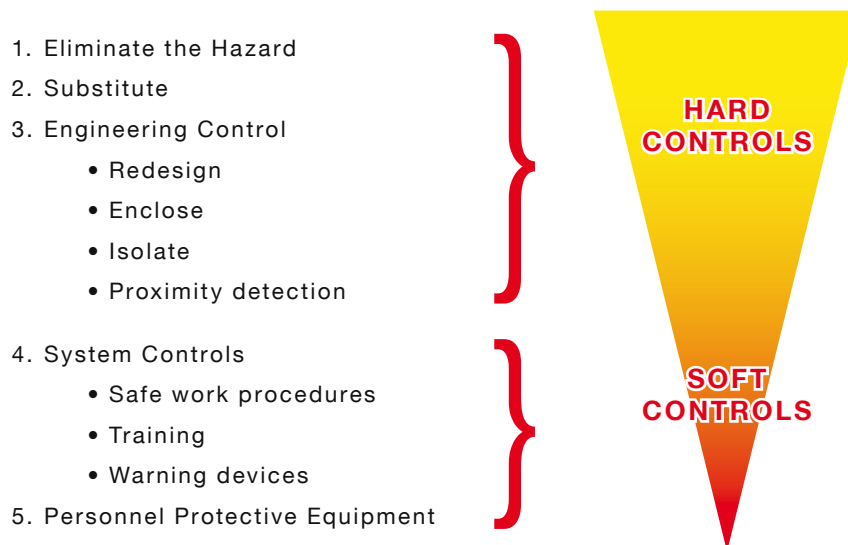


FIGURE 1 HIERARCHY OF CONTROLS

2.2 DOCUMENTATION AND RECORD KEEPING

The records and documentation of the design, planning, development (if applicable) and operation of remote control mining equipment should be integrated with the WHSMS. Accurate records shall be kept of all stages of the remote control mining equipment's life cycle (see Figure 2). The following documents shall be kept:

- (a) Documented risk assessments associated with the mine planning process. These should include selection of a mining method that provides a safe work environment for workers and visitors.

NOTE: A visitor should be under constant supervision and control of a worker.

- (b) Safe work procedures including operation and maintenance utilizing OEM documentation and site conditions.
- (c) Testing, repair and recommissioning records, including but not limited to changeout and upgrade of components, software upgrades, and reintroduction of transmitters to site.
- (d) Records of the remote control equipment selection process and purchase details.
- (e) Records of operational checks.
- (f) Records of workplace inspections.
- (g) Testing and maintenance records for remote control equipment, including the remote control receiver, transmitter and ancillary equipment.
- (h) Records of training, competency assessments and reassessment.
- (i) Records of hazard reporting and follow up.
- (j) Audit and monitoring records.
- (k) Pro forma documents for daily and regular checks on equipment functionality, based on the risks identified.

2.3 TRAINING

The WHSMS shall include a training plan that ensures remote control equipment operators, supervisors and maintenance personnel are trained and assessed for competency. The competency assessment should include a practical component and a theory component. A reassessment program shall be included in the training plan. All workers and visitors entering the operating area of remote control equipment shall be made aware of the hazards and associated controls. For example, the location of no entry zones, no standing zones, and controlled work areas.

2.4 MONITORING, SYSTEMS AUDIT AND REVIEW

Remote control equipment operations and procedures shall include a monitoring, auditing and review process to ensure continued effective implementation. The monitoring, auditing and review process should be part of the continuous improvement process under the WHSMS (Figure 2) and should include the following:

- (a) Monitoring of internal processes and records for completeness, accuracy and indications of system failures.
- (b) Monitoring of external safety information and safety alerts/bulletins, including those from OEMs, regulators and recognized industry stakeholders.
- (c) Periodic audit for procedural compliance.
- (d) Periodic audit for implementation of remedial actions.
- (e) Review of records and analysis of results, both routinely and after unplanned movements or incidents/accidents involving remote control equipment, to identify corrective actions or improvement opportunities.

NOTE: Outcomes from these management process reviews should, where relevant, be used to improve the WHSMS and mine planning and operational procedures, and be passed on to OEMs and other stakeholders.

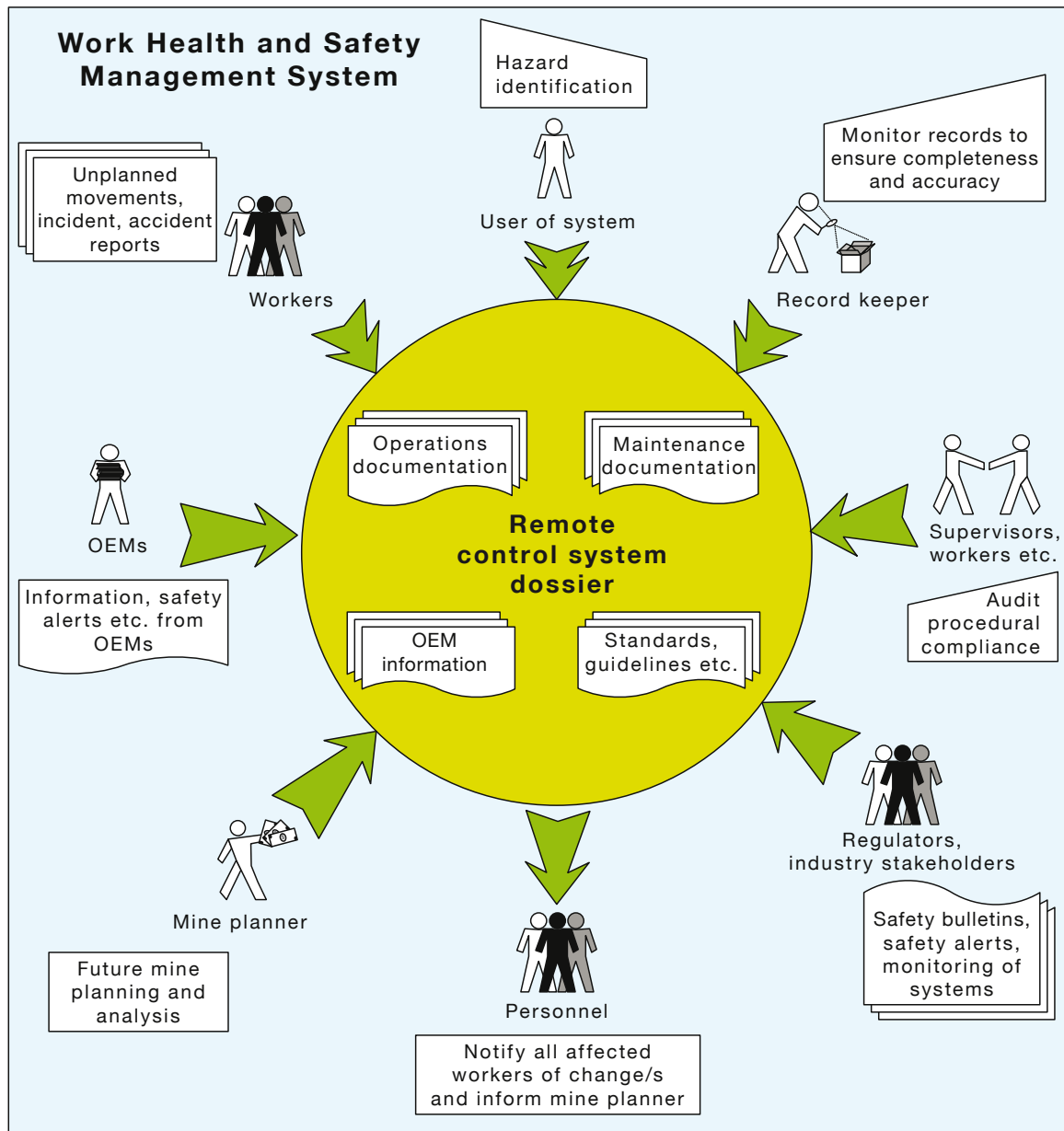


FIGURE 2 MANAGEMENT OF A REMOTE CONTROL SYSTEM

SECTION 3 RISK IDENTIFICATION

3.1 GENERAL

This Section outlines the main hazards associated with the use of remote control mining equipment in underground coal mines, and outlines some of the controls currently used in the industry to address them.

These lists are not exhaustive. There may be other hazards, including site-specific hazards, which shall be identified and controlled.

NOTE: Additional information that may assist in the risk management process is contained in Appendix A. Appendix B provides supporting reference material, and tables issues to be considered with possible controls.

3.2 RISK IDENTIFICATION AND ASSESSMENT

It is widely accepted that risk management practices using the various techniques of risk assessment contribute significantly towards the improvement of the safety of complex operations and equipment.

Remote control mining machines have been introduced primarily to improve safety. Safety can be enhanced by moving the operator away from hazards such as falls of ground, dust, gases, noise and vibration. However, the use of remote control mining equipment can expose workers and visitors to other hazards, such as being crushed by the machine being operated or being crushed by other machines. Also, the risk from traditional hazards, such as falls of ground, gas emissions and dust explosions, may be increased in a manner that is not readily recognized.

A systematic approach shall be used to manage any introduction of different hazards and the increase in risk of traditional hazards.

3.3 REQUIRED OUTCOME

The required outcome is that remote control coal mining machinery is operated safely throughout its life cycle and throughout the mine's production cycle.

The three basic risk areas associated with remote control equipment are as follows:

- (a) The risk of the machine itself injuring a person or persons.
- (b) The risk of a machine/mine environment interaction injuring a person or persons.
- (c) The way in which 'traditional' mining risk profiles have been altered due to the use of remote control equipment.

Fundamental to managing the risks is the use of risk assessment as part of an integrated WHSMS to provide a safe workplace through fit for purpose equipment, competent people, effective operating procedures and a controlled work environment, and to do so throughout the life cycle of the mine and the remote control equipment, as shown in Figure 3.

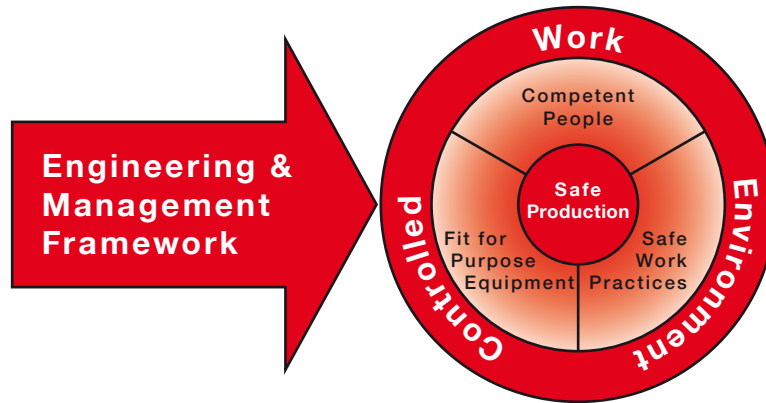


FIGURE 3 NERTNEY WHEEL OF SAFE PRODUCTION

3.4 COMMON RISK CONSIDERATIONS

There are a number of common issues that the user should consider which concern the processes related to remote control equipment.

The underground coal mining working environment has a number of unique environmental hazards that are not found in the surface work environment. The risks associated with mining environmental hazards should be considered throughout the full life cycle of the remote control equipment.

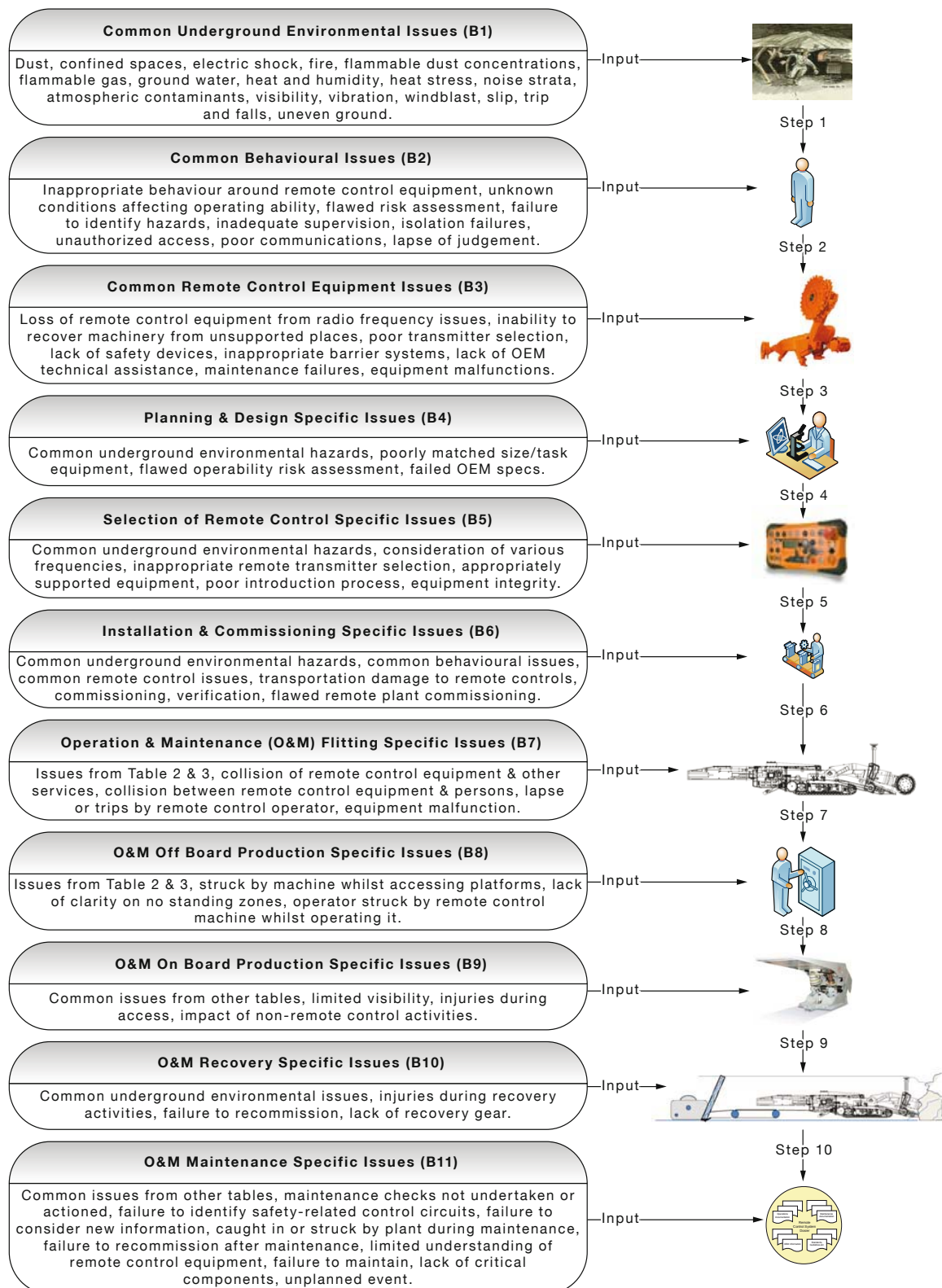
Figure 4 outlines the risk considerations and risk consideration process flow that users should utilize to complete a risk assessment associated with their installation.

NOTES:

- 1 Additional information for each section of Figure 4 is detailed in the tables in Appendix B. The information in Appendix B is not intended to provide a finite compilation of potential controls. Appendix B was developed with industry consultation to aid end users in the development of site-specific risk assessment for the management of the underground work environments into which remote control equipment will be introduced.
- 2 Refer to Paragraphs B1, B2 and B3.

Risk Consideration Process Flow

(Refer to Appendix B for detailed information)



NOTE: Refer to Appendix B for more detailed information.

FIGURE 4 RISK CONSIDERATIONS

3.5 PLANNING AND DESIGN

Hazards and associated risks from remote control equipment should be evaluated at the design stage of the mining operation or intended implementation of remote control equipment to site. This will allow risk controls to be designed into the mining and production plans.

The planning and design process should evaluate all possible mining and associated remote control equipment options, with the view to providing the safest working environment for workers and visitors throughout the full life cycle of the operation.

Mine designers should give consideration to providing a safe work location for remote control mining equipment, workers and visitors.

NOTE: Refer to Paragraph B4 for further information.

3.6 SELECTION OF REMOTE CONTROL EQUIPMENT

The type and configuration of remote control equipment should be considered during the design of the mine to ensure that it is the best suited to the mining conditions.

The equipment selection process should select remote control equipment that will provide the highest level of safety to operators throughout the mining operation life cycle. The physical size and machine configuration should be assessed in the selection process.

NOTE: Refer to Paragraph B5 for further information.

3.7 INSTALLATION AND COMMISSIONING OF REMOTE CONTROL EQUIPMENT

All relevant, competency-based training and supervision that is necessary and recommended by the OEM to achieve the safe installation and commissioning of remote control equipment shall be provided.

The installation and commissioning of remote control equipment at a coal operation should only be performed following consideration of all identified risks and foreseeable misuse of the equipment during the installation and commissioning phase.

NOTE: Refer to Paragraph B6 for further information.

3.8 OPERATION AND MAINTENANCE OF REMOTE CONTROL EQUIPMENT

The operation of remote control equipment in the confines of an underground mining environment significantly increases the risk to workers and visitors, compared to when such equipment is operated in less confined spaces, e.g. on the surface. There is anecdotal evidence that this part of the life cycle has the highest risk profile.

The operation of remote control equipment through the production and maintenance cycles should be controlled as per the Nertney Wheel (Figure 3). The operation cycle and maintenance schedule should also include a reporting system that allows the operator/s to report faults and defects and if necessary remove the unit from service. In the event that modifications or component changes are required, a documented process for tracking and testing should form part of the maintenance documentation.

NOTE: See Paragraphs B7 to B11, which cover flitting, off board, on board, recovery and maintenance specific issues.

3.9 DECOMMISSION

All plant comes to the end of its serviceable and economical life. A procedure that allows for the equipment to be safely decommissioned shall be developed.

A procedure that is suitable and sufficient to ensure that all remote control equipment is disposed of in a safe manner shall be developed.

SECTION 4 SAFE WORK LOCATIONS AND AT RISK BEHAVIOUR

4.1 GENERAL

Fundamental to the safe operation of remote control equipment throughout its life cycle is the provision of safe work locations for workers and visitors. While a number of design and engineering controls are required to be put in place by the OEM and communicated in the machine safety file (or verification dossier; refer to AS/NZS 4871.1), residual risks are present during the operation of the equipment. These include the possibility of an unplanned movement or at risk behaviour/practices. These OEM residual risks shall be communicated to the equipment owner (see Figure 5).

Designated areas shall be established before a machine may be operated in any mode. Appendix A contains drawings of designated areas. These drawings are indicative only.

Each mine shall establish the areas based on their conditions and machines used. The areas shall be as follows:

- (a) Controlled work area.
- (b) No standing zone.
- (c) No entry zone.

The zone locations shall be defined with dimensions by the mine during the operational and maintenance risk assessments. The drawings in Appendix A outline suggested zone locations.

Designation of zone locations should consider interaction of—

- (i) visitors;
- (ii) workers;
- (iii) mine environment;
- (iv) other plant; and
- (v) equipment that interacts with the remote control machine.

NOTE: It is understood that there will be variations in machine configurations. Therefore, coal operators should undertake their own risk assessments to develop machine specific zones.

4.2 CONTROLLED WORK AREA

The basic principle of a controlled work area is to provide workers with a safe location to operate the remote control equipment throughout its life cycle to prevent injuries.

The figures in Appendix A show examples of typical work areas. On the figures the controlled work area for that example is illustrated and requirements for such an area are specified.

The principle of a controlled work area is shown in Appendix A, colour coded green within the figures.

4.3 NO STANDING ZONE

The basic principle of a no standing zone is to remove workers and visitors from the risk area to prevent injuries.

If access to the controlled work area is required by passing through the no standing zone, then appropriate communication and controls (e.g. proximity detection, collision avoidance, etc.) which will prevent the machine from moving shall be implemented.

The figures in Appendix A show examples of typical work areas. On the figures the no standing zone for that example is illustrated and requirements for such an area are specified.

The principle of a no standing zone is shown in Appendix A, colour coded amber within the figures.

4.4 NO ENTRY ZONE

The basic principle of a no entry zone is to prohibit entry of workers and visitors to the area to prevent injury or death. If access to the no entry zone is required, full isolation of all energy sources shall be carried out.

The figures in Appendix A show examples of typical work areas. On the figures the no entry zone for that example is illustrated and requirements for such an area are specified.

The principle of a no entry zone is shown in Appendix A, colour coded red within the figures.

4.5 RISK CONSIDERATION

Poor understanding of the remote control equipment and its interaction with people, other plant and the environment is a recurring problem. Observations from incident investigations following unplanned movements and remote control related accidents identify that equipment operators, supervisors and maintainers need a thorough understanding of how the equipment can operate and the potential for unplanned movements.

4.6 AT RISK BEHAVIOUR

Through workplace observation and investigation of incidents, it is known that workers take risks around remote control machines. Risk considerations shall include supervisor and employee responsibilities, with defined actions and consequences in the event of risky behaviour. This will typically involve OHS committee and management support for actions in the event of risky behaviour.

There needs to be a clear understanding of the safety requirements to achieve a level of risk that is as low as reasonably practicable (ALARP) during the life cycle of the equipment. The hierarchy of controls (refer to Figure 1) shall be considered in developing the controls for at risk behaviour.

Potential solutions may include the following:

- (a) Separation—operation from surface or outbye of working area.
- (b) Engineering—installation of a proximity detection system.
- (c) Procedural—no standing zones.
- (d) Administrative—supervision and reinforcement of controls.

At risk behaviour should be considered throughout the risk consideration process (refer to Figure 4) for the identification of risks associated with the operation of remote control mining equipment.

NOTE: Refer to NSW MDG 5004 for further information.