



Department of **Local Government,**
Industry Regulation and Safety



GUIDE

Principal mining hazard management plans

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Reference

WorkSafe Western Australia, 2025, Principal mining hazard management plans: Guide. Department of Local Government, Industry Regulation and Safety, Western Australia, 18 pp.

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Foreword

This guide was developed to assist mine operators to understand the principal mining hazard risk management process and requirements, and to assist them in documenting a principal mining hazard management plan.

It is intended for mine operators with limited experience in risk management or as a refresher for mine operators reviewing their existing principal mining hazard management plans. While this guidance can assist mine operators to meet the principal mining hazard management plan requirements, it is important for the mine operator to read and understand all duties required under the *Work Health and Safety Act 2020* (WHS Act) and *Work Health and Safety (Mines) Regulations 2022* (WHS Mines Regulations).

The guide sets out the steps for conducting the principal mining hazard identification process and the risk assessment/analysis process for the managing principal mining hazards through the adoption of controls.

How to use this Guide

References to the WHS Act and WHS Mines Regulations are included for convenience and are not to be relied on in place of the full text. Current versions of the Western Australian WHS legislation are available on www.legislation.wa.gov.au.

The words 'must', 'requires' or 'mandatory' indicate a legal requirement exists that must be complied with. The word 'should' indicates a recommended course of action, while 'may' is used to indicate an optional course of action.

See also

- [*Mines safety management system: Code of practice*](#)
- [*Principal mining hazard management plans: Self-assessment*](#)

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1. Legislative requirements

Every mine operator has a duty to have in place a mine safety management system (MSMS) for all mining operations, including exploration.

The MSMS is a framework that enables a mine operator to follow a systematic, risk-based approach to work health and safety. It covers all aspects of health and safety by integrating and documenting all elements of risk management into an overarching system.

Among the obligatory inclusions in the MSMS are plans for managing specific types of risk which are termed 'principal mining hazards'. These have the potential to create incidents with serious consequences.

2. What is a principal mining hazard?

WHS Mines Regulations r. 612

Meaning of principal mining hazard

WHS Mines Regulations r. 627

Identification of principal mining hazards and conduct of risk assessments

WHS Mines Regulations Schedule 19

Principal mining hazard management plans – matters to be considered

The Work Health and Safety (Mines) Regulations 2022 (WHS Mines Regulations) define principal mining hazards at a mine as 'any activity, process, procedure, plant, structure, substance, situation or other circumstance relating to the carrying out of mining operations at the mine that has a reasonable potential to result in multiple deaths in a single incident or a series of recurring incidents'.

Note what the regulations say about the likelihood and consequences associated with principal mining hazards. The test is a 'reasonable potential' to result in multiple deaths in a single incident or 'a series of recurring incidents'.

What is meant by reasonable potential?

A reasonable potential is a real possibility or likelihood that an incident may occur. If the risk of an incident is theoretically possible, but extremely unlikely to occur, it should not be considered to have a reasonable potential to occur. For example, natural seismic activity occurs in Australia but, in most cases, it would not constitute a principal hazard unless a mine is within a zone of significant influence and effect from that activity. However, mines where mining operations can induce seismic activity of a magnitude that could affect the safe operation of the mine may have to consider seismic activity as a principal mining hazard.

What is a series of recurring incidents?

This term refers to the type of incident that has the potential to recur because workers will continue to be exposed to the same hazard. Heavy and light vehicle interaction is an example of a recurring hazard. Sometimes only one or two workers are exposed to the interaction of heavy and light vehicles at any time but if the same work needs to be done on a recurring basis, this may give rise to a series of recurring incidents. Once identified, they must be assessed both separately and in combination in order to identify any interactions that may flow from one risk to another.

The risks associated with principal mining hazards are not always obvious and, much like the overall hazard, what poses a risk today may not in future, or new risks may be introduced. The identification of principal mining hazards is a continuing process.

3. How to identify principal mining hazards

WHS Mines Regulations r. 627

Identification of principal mining hazards and conduct of risk assessments

WHS Mines Regulations Schedule 19

Principal mining hazard management plans – matters to be considered

The first task in preparing the plans for managing the principal mining hazards is to identify which of the mine's hazards meet these levels of likelihood and consequences.

Hazard identification is usually a qualitative process undertaken by a group of skilled and experienced people with knowledge of the operation or activities being undertaken. Those who will be exposed to the hazards can make a valuable contribution to identifying the hazards.

There are several ways to identify principal mining hazards at a mine or exploration site. These may include:

- reviewing existing risk assessments
- consulting with workers
- incident investigations
- workplace inspections and observations
- safety committee recommendations
- workers' complaints/suggestions
- historical safety records
- safety audits.

Each mining operation is different and operations will change over time. As a guide, principal mining hazards may include:

- instability of geotechnical structure
- inrush of any substance
- mine shafts and winding system
- roads or other areas where mobile plant operate
- fire or uncontrolled explosion
- gas outbursts in an underground coal mine
- spontaneous combustion in an underground coal mine.

There is detailed information about matters to be considered for each of these sources of hazard in Schedule 19 of the WHS Mines Regulations.

In addition to these specific sources, there may be other principal mining hazards present at the operation that have a reasonable potential to result in multiple deaths in a single incident, or a series of recurring incidents.

Such other hazards may include:

- air quality or dust or other airborne contamination (such as from asbestos, silica, radiation or sodium cyanide exposure)
- structural integrity or failure
- lone and isolated work
- arc flash and electrocution
- natural disaster from flood, cyclone, storm or earthquake
- proximity to old workings
- uncontrolled release of pressurised hazardous chemicals
- working at heights
- working in confined spaces.

If workers are exposed on a recurring basis to any hazard that has a reasonable potential to result in a series of fatalities over time, the hazard should be identified as a principal mining hazard, and a principal mining hazard management plan (PMHMP) must be prepared.

In identifying principal mining hazards, a mine operator should consider each hazard individually and in combination with other hazards, in case there are interactions between them.

4. Selecting the appropriate risk management process

WHS Mines Regulations r. 627

Identification of principal mining hazards and conduct of risk assessments

For each principal mining hazard that has been identified, the mine operator must use an appropriate risk assessment process to investigate and analyse it.

Some questions to ask when selecting a risk assessment process are:

- Is it suitable for the type and complexity of the operation and the nature of all the hazards present?
- Is it workable and not overly complicated for the operation's needs?
- Is it adequate to differentiate between likelihood and consequence?
- Is it able to assist in understanding and selecting the risk control measures?
- Is it capable of assessing cumulative risk and the potential effect of risk reduction measures?
- Does it challenge the assumption that no new knowledge is required about the principal mining hazard?
- Does it provide information that can be understood by those exposed to the principal mining hazard?
- Does it ensure an appropriate group of workers is consulted about and actively involved in the assessment?
- Is it able to identify and address uncertainties and human factors?
- Is it consistent with the operation's safety policy and the MSMS?
- Can it document all methods, results, assumptions and data?
- Can it be used for continuous improvement?

The process should deliver specific outcomes. It should:

- provide knowledge, awareness and understanding of the risk of the principal mining hazard and how to prevent incidents for inclusion in the PMHMP
- identify the major factors contributing to risk
- identify, evaluate, define and justify the selection, or rejection, of risk controls
- allow the adequacy of selected controls to be tested
- demonstrate that risk is eliminated or reduced so far as is reasonably practicable
- identify concerns to be addressed in community consultation where required.

Each method and analysis process has limitations and requires different levels of resources and detail. Some processes may be better suited to particular principal mining hazards and types of mining operations than others.

Whatever the process chosen, to be effective it should be logical, comprehensive, systematic and repeatable. A process is comprehensive and systematic when it includes all operations, activities, areas or phases of operations, and addresses all aspects of the hazard (that is, the likelihood and consequence) carefully, and applies the same process at each step.

The risk assessment must be conducted by a person or group who are competent to conduct the assessment, having regard to the nature of the hazard.

5. Risk assessment techniques for identified principal mining hazards

WHS Mines Regulations r. 627

Identification of principal mining hazards and conduct of risk assessments

Risk assessment allows workers to understand what situations could occur at the mine and their relative risk levels. Knowing the risk level helps prioritise actions for risk reduction.

This could be documented as a list, or created as a visual display (drawn on a marker board or paper using sticky notes or in a simple drawing package) linking the hazard, control measures, principal mining hazard event and outcome. An example of a visual display used by many mines is a bow-tie diagram (see Figure 1).

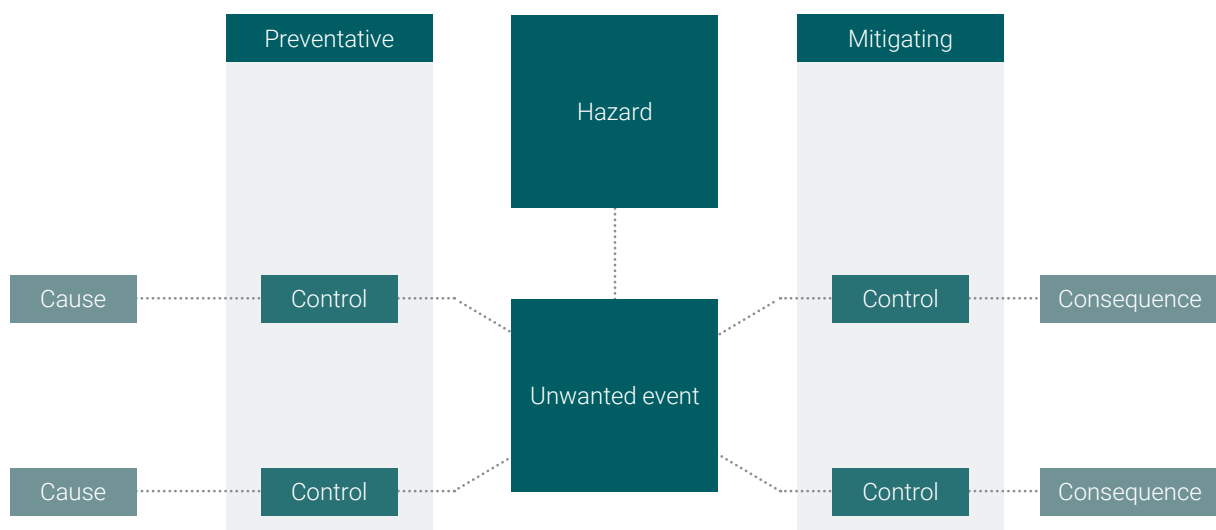


Figure 1 Typical bow-tie analysis indicating preventative and mitigating controls

A bow-tie diagram shows on its left-hand side the control measures which act to prevent the principal mining hazard event from occurring (preventative controls). Controls on the right-hand side are those that reduce the severity of harm caused by the principal mining hazard event (mitigating controls).

Displaying the principal mining hazard event with associated control measures helps everyone understand the importance of control measures and the principal mining hazard event they protect against.

Other analysis methods may include:

- preliminary hazard analysis (PHA)
- hazard analysis (HAZAN)
- hazard and operability study (HAZOP)
- workplace risk assessment and control (WRAC)
- fault tree analysis (FTA)
- event tree analysis (ETA)
- human error analysis (HEA).

Proprietary tools are available, but bow-ties can also be drawn by hand or developed with standard office product software. There is no single right way to develop a bow-tie. A suggested method to develop a bow-tie is:

- Start with the principal mining hazard event in the centre of the bow-tie that can result from a particular hazard.
- From the hazard identification (HAZID), list the possible threats or scenarios that could lead to the principal mining hazard event.
- Show the controls which prevent the threat or scenario leading to the principal mining hazard event (these are preventative controls, as they act to prevent the principal mining hazard event from occurring).
- List the range of possible outcomes of the principal mining hazard event.
- Show the controls which stop the principal mining hazard event outcomes from occurring (which are mitigating controls, as they act to mitigate the severities of the principal mining hazard event).

A bow-tie is an ideal analysis tool for depicting the principal mining hazard with causes, preventative and mitigating controls, and expected outcomes. The principal mining hazard must then be reassessed using the selected risk assessment method, considering the principal mining hazard events and the existing control measures to determine the following:

- What is the potential severity of harm caused by the principal mining hazard event? Record any assumptions and comments regarding this decision. Remember to consider any harm to any person. It is common for there to be several different severities from a single principal mining hazard event.
- What is the likelihood of the principal mining hazard event occurring and resulting in harm? Record any assumptions and comments regarding this decision. Remember to consider the likelihood of any harm to any person.
- Consider the effectiveness of existing controls. Is each control applicable to this scenario and how well does it work? Controls are rarely 'perfect'.

6. Risk controls

WHS Mines Regulations r. 617

Managing risks to health and safety

WHS Mines Regulations r. 618

Review of control measures

WHS Mines Regulations r. 628

Preparation of principal mining hazard management plan

The processes around identifying and assessing principal mining hazards are intended to ensure that the best control measures are adopted for managing the risks associated with the hazard.

Mine operators should ensure that control measures identified in risk assessments are clearly defined to ensure that they are measurable and auditable, and to ensure that their details are fully documented in the PMHMP.

6.1. Hierarchy of controls

The best approach to risk control is achieved through the hierarchy of controls. Where practicable, a risk must be eliminated. If this is not possible, the mine operator must implement effective risk control measures to minimise risks by:

- substituting the hazard with something that gives rise to a lesser risk
- isolating the hazard from any person exposed to it
- implementing engineering controls

If risk remains, the duty holder must minimise the remaining risk, so far as is reasonably practicable, by:

- implementing administrative controls
- ensuring personal protective equipment (PPE) is provided.

If a single control is not sufficient for the purpose, a combination of controls may be used to minimise risks.

The mine operator should ensure that control measures are:

- fit for purpose (effective as verified by monitoring and testing)
- suitable for the nature and duration of the work
- installed, set up and used correctly.

All workers, including contractors and visitors to the site, should be aware of the controls and how to implement them.

Some hazards pose such high levels of risk that control measures are prescribed by the *Work Health and Safety Act 2020* and WHS Mines Regulations. As a minimum, these prescribed controls must always be used and be supplemented by additional controls to assist in further minimising the risk.

Emerging hazards need to be risk assessed and the effectiveness of existing risk assessments and implemented controls evaluated, with the MSMS being updated to reflect any operational changes.

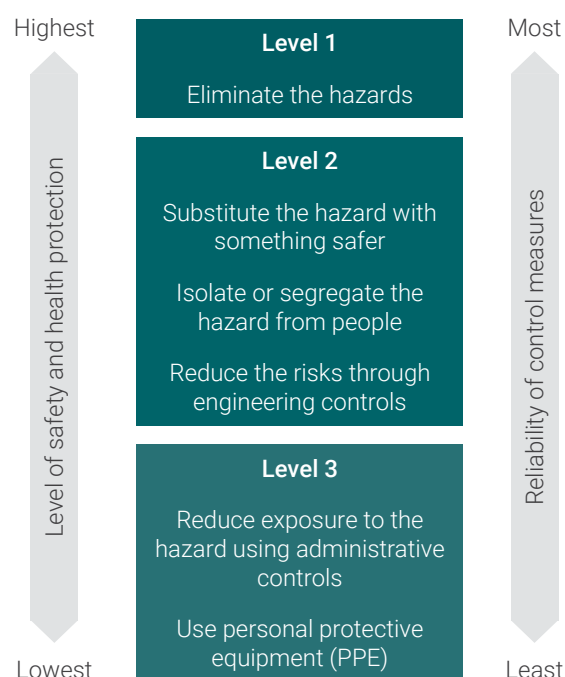


Figure 2 Hierarchy of control

6.2. Critical controls

Critical controls are controls that are crucial in preventing or mitigating the consequences of a principal mining hazard. The absence or failure of a critical control will significantly increase the risk of a principal mining hazard occurring, despite the existence of the other controls. They are considered important enough to warrant additional monitoring and reporting to ensure they are implemented and maintained to high levels of effectiveness.

Selecting the critical controls involves assessing all the controls to identify if they are critical. It is an important step.

The criticality of a control has an important bearing on the maintenance frequency, test regime and management action if the measure has to be disabled. Some factors that might be considered are that:

- the control measure is relied on to control a number of different significant hazards
- the control measure is relied on to prevent the most likely cause of significant incidents
- the control measure is relied on to reduce or mitigate incidents having potentially very severe consequences
- other control measures that provide backup are known to be of poor reliability or effectiveness
- there are a small number of barriers for a significant hazard.

6.3. Control effectiveness

A range of performance indicators is required for all control measures, particularly for those controls deemed critical. The performance indicators measure both how well the controls are performing and how well the management system is monitoring and maintaining the controls. The performance indicators for control measures will generally relate to some standards or target levels of performance. The measures may be qualitative or quantitative. They may include absolute targets allowing no deviation or targets which may have scope for limited tolerable deviation.

It is recommended that control checklists are compiled to enable a site to validate that a control has been properly implemented and is functioning as designed. These checks must be carried out at a sufficient frequency to ensure the controls are remaining effective.

The items covered should include:

- planning and design assessment of the critical control
- implementation of the control
- human factors that may impact on the integrity or application of the control monitoring activities to verify the control is effective through verification and testing.

For critical controls, the following process should be followed:

- Define the objectives for each critical control as well as performance requirements and how performance is verified in practice.
- Identify current activities that affect the critical control's performance and any human factors that may impact on the critical control's performance.
- Describe activities to verify performance and reporting requirements.
- Finally, identify what would trigger immediate action to stop or change the operation and/or impose the performance of the critical control.
- The following questions should be considered when defining each of these points:
 - What are the specific objectives of each critical control?
 - What performance is required of the critical control (this is sometimes referred to as a performance standard)?
 - What activities support or enable the critical control to perform as required and specified?
 - What checking is needed to verify that the critical control is meeting its required performance? How frequent is the verification needed? What type of verification is needed?
 - What would initiate immediate action to shut down or change an operation or improve the performance of a critical control?

6.4. Documenting your reason for controls

Controls may be accepted for implementation, some may be rejected, and others may require further investigation before a decision can be made.

The WHS Mines Regulations require the mine operator to document which control measures have been accepted for implementation and why, as well as which ones have been rejected and why.

There are likely to be some control measures which require further investigation. These must be recorded too. Ensure a competent person is made responsible for implementation or further investigation and a due date is assigned.

7. What is a principal mining hazard management plan?

WHS Mines Regulations r. 627

Identification of principal mining hazards and conduct of risk assessments

WHS Mines Regulations r. 628

Preparation of principal mining hazard management plan

A PMHMP is a document that sets out how the mine operator will manage risks to workers' health and safety associated with a principal mining hazard.

So the next requirement after identifying and assessing the principal mining hazards and determining which controls are required is to prepare a management plan for each of the hazards.

Note that it is not a single plan for the entire mine or exploration operation. This is a plan for each identified principal mining hazard.

A PMHMP can only be used at more than one site if the hazard and its controls are the same. The assessment process to determine required controls must occur at each site and take into account the size and nature of the mining operation as there can be some variance between sites. For example, traffic management hazards and plans may be different between mining operations.

The PMHMP must:

- describe each principal mining hazard at the operation
- set out how the risks arising from that hazard have been assessed
- describe the control measures and implementation to manage the risks associated with the hazard.

To provide for the management of all aspects of the risk controls relevant to the principal mining hazard, the PMHMP must specifically describe:

- the nature of the principal mining hazard to which the plan relates
- how the principal mining hazard relates to other hazards at the mine
- the analysis methods used in identifying the principal mining hazard to which the plan relates
- a record of the risk assessment conducted in relation to the principal mining hazard
- the investigation and analysis methods used in determining the control methods to be implemented
- all control measures to be implemented to manage risks to health and safety associated with the principal mining hazard
- the arrangements in place for providing the information, training, instruction and supervision in relation to the nature of the principal mining hazard and the control measures implemented
- any design principles, engineering standards and technical standards relied upon for control measures for the principal mining hazard
- the reasons for adopting or rejecting all control measures considered.

There are other specific requirements for the PMHMP. As far as possible, it must be readily understandable by the people who will use it.

It must be made readily accessible by management, supervision and workers.

The mine operator must ensure that the development of the PMHMP is undertaken in consultation with relevant workers and representatives.

All the PMHMPs for a site must form part of the MSMS for the site or the organisation. In practice, these plans can be integrated by:

- updating the risk management procedure to include all hazards
- referencing PMHMPs in other relevant procedures
- referencing relevant work instructions, policies and procedure.

8. Performance standards, audits and review of the PMHMP

WHS Mines Regulations r. 623

Performance standards and audit

WHS Mines Regulations r. 625

Review (MSMS)

WHS Mines Regulations r. 629

Review (PMHMP)

Because an MSMS includes any PMHMP for the mine, it must contain performance standards for measuring the effectiveness of the PMHMP. In addition, it must also contain a system for auditing the effectiveness of the PMHMP against the performance standards, including the methods, frequency and results of the audit process.

Performance standards provide a reference comparison designed to enable mine operators to determine how effective the planning, execution and implementation of the mine's PMHMP risk management is.

Risks covered in the PMHMP must be controlled so far as is reasonably practicable.

An example of a performance measure is where there is an exposure standard that must not be exceeded. This is essentially a performance standard that pertains to personal exposure monitoring and health monitoring of workers.

When preparing a PMHMP, operators should include triggers for shutdown, review or investigation and ensure that any actions required for absent or ineffective control measures are documented.

8.1 Use of trigger action response plans

A trigger action response plan (TARP) is an integral part of a PMHMP that provides guidance on the actions to be taken by workers when a change in mine site conditions occurs that are no longer considered normal.

However, a TARP should be put in place only after a risk assessment has verified the selection of the most effective control measures in relation to the hazard.

For a TARP to be applied effectively it should:

- consider actions to be taken at specified levels of risk, relative to the risk posed by the hazard
- be simple and robust to ensure immediate actions are understood and able to be implemented by workers
- consider the workers and equipment required to implement actions.

8.2 Auditing the PMHMP

Competent people should undertake audits of the PMHMP on a regular basis. Operators should consider both internal and external audit programs. Audits need to examine the adequacy, implementation and compliance with the PMHMP.

The areas that may be audited include:

- hazard identification and risk assessment
- control effectiveness or verification data
- incident and injury reporting data
- workplace inspection data
- compliance with occupational exposure limits and biological indices.

The final audit report needs to include the findings of the audit, recommendations and the actions that will be taken to correct the issues raised. The person(s) responsible for implementing the corrections should be stated in the audit report.

Records of the audit of the PMHMP must be kept in accordance with requirements of the MSMS. Records should be made available to worker representatives.

For further guidance on performance measures, reviews and audits refer to [*Mine safety management system: Code of practice*](#).

8.3 Review

Operators must review the PMHMP at least once every three years or after an incident or other circumstance as outlined in the WHS Mines Regulations. The specific provisions for reviewing a PMHMP are contained in regulation 629.

The review determines whether the controls continue to be suitable, consistent with current good practice and effective in managing the risks associated with the principal mining hazard.

The PMHMP must also be reviewed and revised, as necessary after:

- the control measures no longer control the risk (e.g. if monitoring or an incident indicates the control measure is not working)
- a change in the workplace occurs (this could include the workplace itself or the work environment or changes to the system of work or procedures)
- a new hazard or risk is identified
- a consultation under the WHS laws indicates a review is necessary
- the occurrence of any event specified in the PMHMP as requiring a review of the PMHMP
- an audit of the MSMS indicates a control measure is deficient
- if requested by a health and safety representative
- any incident occurs that requires the regulator to be notified.

When reviewing the PMHMP, the risk assessment used and referred to in the PMHMP should be reviewed first. There may be new risks that need controls, or existing risks that have changed, requiring controls to be changed, or new methods to control a risk.

During the review, the mine operator should consider any other relevant information gathered during:

- routine risk appraisals and assessments
- monitoring and results of inspections by the operator or the regulator
- a review of TARPs
- investigations of incidents or near misses
- feedback from workers or health and safety representatives.

The PMHMP and supporting documents might need to be revised and reissued after the review. Make sure that workers are informed about any updated documents and are trained or retrained when required. New workers will need to be inducted and trained in the risks and controls implemented by the operator.

Operators must keep written records relating to the review and revision of the PMHMP in the PMHMP.

The publication [Mine safety management system: Self-assessment](#) is available to assist the review process for the mine safety management system at the mining or exploration operation.

Appendix 1: Further information

The following guidance may provide further information:

Work Health and Safety Commission

- [*Mine safety management system: Code of practice*](#)
- [*How to manage work health and safety risks: Code of practice*](#)

WorkSafe Western Australia

- [*Mines safety management systems: Self-assessment*](#)
- [*Principal mining hazard management plans: Self-assessment*](#)

International Council on Mining and Metals (ICMM)

- [*Health and safety critical control management: Good practice guide and implementation*](#)
- [*Health and safety critical control management: Good practice guide*](#)
- [*Critical control management: Implementation guide*](#)

Other resources

- [*National minerals industry safety and health risk assessment guideline*](#)
- AS ISO 31000 Risk management - guidelines

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