



NSW DEPARTMENT OF
PRIMARY INDUSTRIES

GUIDE TO REVIEWING A RISK ASSESSMENT OF MINE EQUIPMENT AND OPERATIONS

MDG 1014

*This Guide should be read in conjunction with
MDG 1010 Risk Management Handbook*

JULY 1997

FOREWORD

This guideline provides information to assist department personnel, accredited assessing authorities, mine management, and those involved in the review of the risk assessment process.

Advancement in technology and management systems too often outstrip the ability of experts to provide exacting community standards for the safe and effective operation of management systems and equipment. The ideal workplace would have fit for purpose equipment, competent personnel, management systems in place, all within a known environment. In reality inherent hazards associated with technology and management of technology within the mining environment requires a process to be utilised not only to reduce hazards to an acceptable level but also produce management systems appropriate for the business. This demands the adoption of a structured process for the identification of hazards and evaluation and control of work related risks.

The Department of Mineral Resources is charged with the responsibility of promoting high standards of safety within the mining industry. A comprehensive legal framework exists under the Occupational Health and Safety Act, Mines Inspection Act and Coal Mines Regulation Act, requiring organisations to manage their activities in such a manner as to anticipate and prevent circumstances which may result in occupational injury or death. The Risk Management Handbook for the Mining Industry (MDG 1010) offers a process to meet such requirements. This guideline “Guide to Reviewing a Risk Assessment of Mine Equipment and Operations” (MDG 1014) assists in the identification of any weaknesses in the process used, assists those responsible for the assessment to remedy the weaknesses in the assessment reviewed and future assessments and assists mine managers and mine workers to improve the safety performance of their mines.

The preparation of this document through a working committee involved the input and support from the following persons and organisations. Professor Mark Tweeddale (Australian Centre of Advanced Risk and Reliability Engineering Ltd) and personnel from the Department of Mineral Resources namely A. Reczek, L. Roberts, G. Cowan, G. Jervis (Chairperson) and R. Hodson. It is recognised for future additions any alterations adding value to this document will be gratefully appreciated. Comments on any aspect of this guideline should be submitted in writing to:

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1. INTRODUCTION

1.1. ROLE OF THE DEPARTMENT OF MINERAL RESOURCES IN MINE SAFETY

When reviewing a risk assessment, it is important to bear the following in mind.

- It is impossible for the Department to *ensure* safety.
- The mine management and mine workers have the fundamental role in ensuring high standards of safety.
- It is necessary for mine management and mine workers to accept responsibility for achieving the required high safety standards, in accordance with the Occupational Health and Safety Act and other Acts.
- The role of Department is to encourage, facilitate and monitor that acceptance and the resulting level of safety.
- It is not possible to check the standard of safety achieved in relation to major accidents by counting the frequency of them, i.e. one cannot confidently measure the *output* of the safety management programme in relation to major accidents.
- Therefore the Department requires adoption of methods which will lead to high quality *input* to safety management.
- Risk assessment is a proven technique for improving the quality of input to safety management, aiming to *prevent* accidents by “debugging” designs and operating methods etc. before accidents occur, rather than responding to accidents which have happened and aiming to prevent recurrence.

1.2. OBJECTIVE OF THIS GUIDE

When read in conjunction with the Risk Assessment Guide, this document aims to equip those undertaking a review of a risk assessment to:

- identify any weaknesses in the process used;
- assist those responsible for the assessment to remedy the weaknesses in the assessment reviewed and future assessments;
- assist mine managers and mine workers to improve the safety performance of their mines

1.3. OBJECTIVES OF RISK ASSESSMENT

The objective of risk assessment is to assist in effective management of risks, by identifying:

- which risks are most in need of reduction, and the options for achieving that risk reduction,
- which risks which need careful on-going management, and the nature of that on-going management.

1.4. OBJECTIVES OF REVIEWING RISK ASSESSMENTS

The objectives of the Department in having a risk assessment reviewed are:

- to identify any weaknesses in the processes adopted by those responsible for the safety of the machinery, equipment or method being studied, and so minimise the likelihood of any significant risk being overlooked or inappropriately treated;
- to assist those responsible to improve their approach to future risk assessments;
- to promote effective pro-active approaches to safety management in mines

The processes adopted must address the essential requirements set out in Section 2.1 of the Mine Risk Management Handbook.

2. ESSENTIAL FEATURES OF A RISK ASSESSMENT

As set out in the Risk Assessment Guide, the essential features of a risk assessment are:

- Use of a *team* with appropriately varied and relevant experience for risk identification.
- Use of a *detailed and systematic approach* for risk identification
- Use of a *comprehensive checklist* of possible problems as part of the systematic approach
- Definition of the *key questions to be answered and decisions to be made* before undertaking the risk assessment
- Definition of a *safety standard* to be reached, either in words or in figures; or definition of the level of expenditure of financial or staff resources to be devoted to risk management
- Identification of both those *high risks* which need to be reduced, and those possible *high consequence events* which need to be prevented
- Listing of the *risk reduction actions* to be taken, and a *timetable* for the early stages of the work
- Listing of the *routine management actions* to be introduced or continued with the aim of preventing occurrence of the high consequence events (including a *monitoring programme* for operational employees at appropriate levels in the organisation, and an *auditing programme* for people outside the line management)

3. ESSENTIAL CONTENTS OF A RISK ASSESSMENT REPORT

The essential features of a risk assessment report are:

1. a brief description (with diagrams if necessary) of the machinery or equipment being studied;
2. a brief summary (e.g. 1 to 2 pages) of the context from the strategic, corporate and risk management viewpoints;
3. a list of the people involved in the risk identification step, together with their organisational roles (and hence experience which they brought to the study);

4. an outline of the approach used to identify the risks , including a list of the guidewords if Hazop or a similar method were used;
5. an outline of the method adopted for assessing the likelihood and consequences of the risks
6. two lists (A and B) of the identified risks, ranked according to:
 - List A: the assessed risk;
 - List B: the magnitude of the consequences;
7. a discussion of the basis used to define the safety standard to be achieved, or the level of expenditure of financial or staff resources in managing risks;
8. a list of the main actions proposed to reduce the risks from those ranked highest of List A;
9. a list of the controls (equipment or procedures etc.) in place, or proposed, for management of the risks ranked highest on List B;
10. a list of the *routine management actions* which will be introduced or continued with the aim of preventing occurrence of the high consequence events (including a *monitoring programme* for operational employees at appropriate levels in the organisation, and an *auditing programme* for people outside the line management);
11. an outline of the timetable for implementation of the main actions, including a date for completion of implementation of all listed actions.

4. CONDUCTING THE REVIEW

Each person who reviews a risk assessment tends to develop his or her own approach. However, a sound approach has at least three phases:

1. a brief reading of the full report, with the aim of becoming familiar with the nature and scope of the assessment;
2. a more detailed study of the main requirements;
3. assembly of the observations to form a balanced view of the assessment as a whole.

Two documents are set out in Appendices 1 and 2, as an aid in the review.

- The Checklist (Appendix 1) is an aid both to checking that the essential requirements have been met, and to recording in summary form your impression of the standard of the various features of the assessment. The scoring system on the Checklist, while subjective, provides an explicit way of recording your impressions.
- The Worksheet (Appendix 2) is a structured way of assembling and recording your impressions about each of the important features of the assessment while studying it, as a basis for preparing your reply to the author of the assessment report. It becomes your record of your review, which you can refer to in the future if you ever have the need.

The following approach is suggested as a guide.

1. Read the risk assessment briefly right through, not concentrating on any particular part, simply to get a broad appreciation of:
 - the scope;
 - the methods used;

- the conclusions reached.
2. Complete the first half of the Checklist (Appendix 1). This is a way of summarising the contents of the assessment, and highlights sections which may be missing and which need to be looked for in the more detailed study.
 3. Read the assessment a second time, making notes on the Worksheet (Appendix 2) under the questions as appropriate. Also, check whether this second and closer reading locates material required by the top half of the Checklist which was missed in the first reading.
 4. Carefully consider the comments collected about each of the questions on the Worksheet, then complete the lower half of the Checklist.
 5. Draft the response to the author of the risk assessment, commenting briefly on the good features and outlining the nature of any weaknesses and what additional work or actions (if any) are required.
 6. Discuss the response with the author of the risk assessment to ensure that he or she has the opportunity to correct any misunderstandings.
 7. Revise and finalise the response if necessary, then send it to the appropriate person at the submitting organisation, with copies to the author and the Chief Inspector at the Department of Mineral Resources as appropriate.

5. COMMON FAULTS TO BE LOOKED FOR

The assessment process, relying on a post-event study of a risk assessment report, cannot be expected to identify all defects. For example, it may not be evident when reviewing the report that the study team, while comprising a group of suitably experienced people were dominated by one person, or were unable for some reason to speak openly.

5.1. OMISSION OF CREDIBLE ACCIDENTS OR INCIDENTS

Perhaps the most important weakness is omission of credible accident or incident scenarios, and a concentration on those scenarios which are most easily assessed.

For this reason, it is helpful if the reviewer attempts to postulate accident scenarios before reviewing those identified in the study, and then checks whether they, or similar scenarios, were identified in the study. This is a form of check on the thoroughness of the essential risk identification step. In particular, the reviewer should look for evidence in the report that consideration has been given to identification of high-consequence events which could result from a single failure of equipment, or a single human error.

5.2. UNWARRANTED OPTIMISM

There is a tendency for a risk analyst to view optimistically either the safeguards which exist or proposed by the operating organisation, or proposed as a result of the risk study identifying a need for improvement of safety.

This is an insidious trap which can catch not only members of the organisation itself but also “independent” consultants. A consultant who works closely with the client (as is very desirable) finds himself or herself unconsciously becoming a member of the clients “team”, and viewing the proposals through the client’s eyes. Further, no consultant wants to admit to a client an inability to define adequate safeguards. (It is necessary for a risk consultant to ask himself or herself frequently “Is this a balanced view, looked at from the outside?”)

For this reason, a reviewer should study the wording of the report very carefully, looking for forms of expression which suggest a loss of detached independence.

5.3. UNSTATED OR UNSUPPORTED ASSUMPTIONS

A major problem arises from implicit and unstated assumptions, and from stated but unsupported assumptions.

For example, frequency data used in risk studies is often taken from data banks, or even from other studies, with insufficient thought about whether it is appropriate for the particular facility being studied. The source of such data is often organisations which have above-average management, as poorly managed organisations are unlikely to contribute to data banks. The applicability of that data to any specific facility being studied is often not discussed in the assessment.

For this reason, it is helpful if the reviewer attempts to identify implicit assumptions made in the study, and to form a view of whether these are appropriate.

5.4. USE OF RISK ASSESSMENT TO JUSTIFY A PREDETERMINED POSITION OR DECISION

Risk assessment has often been used to justify a previously made decision or an existing situation. In such circumstances, the staff involved in the study may feel a real or imaginary pressure to adjust the assumptions or data used to produce a result which will be acceptable to management.

For this reason, a reviewer should carefully examine the explicit assumptions and the principal data used, and attempt to identify the implicit assumptions, with the aim of forming an opinion about the overall ‘balance’ of the risk assessment.

5.5. OMISSION OF “COMMON MODE” FAILURES

Another common weakness is the omission of consideration of “common mode failure” in which several apparently independent “barriers” can be weakened by a single cause common to them all.

For example, if an operator is inadequately trained, he or she can both make an error which requires an emergency response, and fail to take that response.

For this reason, where a high-consequence event is reported to be prevented by several “barriers”, the reviewer should actively look for ways in which a weakness in one barrier could increase the chance of weaknesses in the other barriers.

5.6. DIFFICULTY OF ESTIMATING THE LIKELIHOOD OF HUMAN ERROR

A major difficulty in risk assessments is estimation of the risks due to “human error”. Methods exist for such assessment, but they are regarded more as aids to judgement, rather than replacements for judgement.

One of the reasons for regarding human error assessment with care is that the methods for identification and estimation of human error probabilities have a number of important limitations. These include the capacity of people for making creative and unusual errors, and the fact that many plant accidents have been traced back to human errors of a type which would have been difficult to identify before the event, or difficult to quantify if identified. This latter type includes those which result from poor management systems, or poor attitudes and “culture” toward safety. Further, the methods for estimating the probability of human error are not validated, give widely differing results, and are widely regarded more as an art than a science.

For this reason, the reviewer should give close attention to situations in the assessment report where human reliability is critical to safety, and should encourage those responsible for the activity to consider additional backup measures, preferably of a “hardware” type.

6. RESPONSE TO THE ORGANISATION WHICH SUBMITTED THE RISK ASSESSMENT

The response to the *organisation* which submitted the risk assessment should comprise the following.

1. A covering letter addressed to the person who sent the risk assessment;
2. A brief report containing:
 - a) a brief comment on any essential topics which have been omitted;
 - b) a brief comment on the standard of the topics which have been addressed, i.e. a summary of the comments on Part 1 of the Worksheet;
 - c) a brief comment on each of the views formed when considering the topics listed on Part 2 of the Worksheet.
 - d) A list of the actions needed (if any) which need to be addressed for the risk assessment to be regarded as having been done in accordance with the guidelines.

The following should be *filed* by the person who did the review:

1. the copy of the risk assessment which was submitted for review;
2. the report to the organisation which submitted the risk assessment for review, and the covering letter;
3. the marked-up Checklist (if used);
4. the original Worksheet with the rough comments as made during the review, and any other rough notes.

APPENDIX 1 CHECKLIST FOR USE WHEN REVIEWING A RISK ASSESSMENT

DEPARTMENT OF MINERAL RESOURCES RISK ASSESSMENT REVIEW CHECKLIST

RISK ASSESSMENT:

ORGANISATION: **CONTACT:**

DATE SUBMITTED: / / 19

1. THE REPORT

- 1.1 Is there a description of the operation or equipment being assessed? Yes / No
- 1.2 Is there a summary of the strategic, corporate and risk management context? Yes / No
- 1.3 Is there a list of the people involved in the risk identification step, together with their organisational roles and experience relevant to the risk assessment topic? Yes / No
- 1.4 Is there an adequately detailed outline of the approach used to identify the risks? Yes / No
- 1.5 Is there an outline of the method used for assessing the likelihood and consequences of the risks? Yes / No
- 1.6 Are there two lists of identified risks, ranked by: **a) risk magnitude, and b) consequence magnitude?** Yes / No
- 1.7 Is there discussion of the basis for defining either the safety standard to be achieved, or the level of risk management expenditure? Yes / No
- 1.8 Is there a list of the main actions to be taken to reduce risks and to manage risks? Yes / No
- 1.9 Is there a timetable for implementing the main actions? Yes / No
- 1.10 Does the report specify a requirement for a working audit required after completion of all implementation stages? Yes / No

2. THE PROCESS USED

How do you rate the following:

	Poor	Good
2.1 The range of expertise of team which did the study	1 2 3 4 5	
2.2 The appropriateness of the degree of detail of the study	1 2 3 4 5	
2.3 The comprehensiveness of the systematic approach	1 2 3 4 5	
2.4 The identification of the key risk scenarios to be addressed	1 2 3 4 5	
2.5 The bases for deciding the required safety level or effort	1 2 3 4 5	
2.6 The method for assessing likelihood and consequences	1 2 3 4 5	
2.7 The thoroughness of consideration of planned <i>risk reduction actions</i>	1 2 3 4 5	
2.8 The thoroughness of consideration of <i>existing or planned risk controls</i>	1 2 3 4 5	
2.9 The objectivity and balance of the study (i.e. not unduly optimistic or pessimistic)	1 2 3 4 5	

Signed:

Date: / / 19

Position:

APPENDIX 2: WORKSHEET FOR USE IN SECOND READING OF THE RISK ASSESSMENT

**This is a working document to assist in assembling comments
when reviewing a documented risk assessment.**

**To be filed as a record of the review,
and to assist in answering any future queries
about the basis for the conclusions reached.**

MINE RISK ASSESSMENT REVIEW WORKSHEET

- 1. *COMMENTS ON THE ADEQUACY OF THE FOLLOWING FEATURES
OF THE REPORT***
- 1.1 The description of the operation or equipment being assessed**

- 1.2 The summary of the strategic, corporate and risk management context**

- 1.3 The list of the people involved in the risk identification step, together with their
organisational roles**

- 1.4 The detailed outline of the approach used to identify the risks**

2. *HOW DO YOU RATE THE FOLLOWING:*

2.1 The range of expertise of team which did the study

2.2 The appropriateness of the degree of detail of the study

2.3 The comprehensiveness of the systematic approach

2.4 The identification of the key issues to be addressed

2.5 The bases for deciding the required safety level or effort

2.6 The method for assessing likelihood and consequences

2.7 The thoroughness of consideration of planned *risk reduction actions*

2.8 The thoroughness of consideration of *existing or planned risk controls*

2.9 The objectivity and balance of the study (i.e. not unduly optimistic or pessimistic)

Signed: **Date:** / / 19

Position:

