

**Occupational health risk assessment: overview, model and guide for
the South African mining industry towards a holistic solution**

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PREFACE

The South African mining industry needs a balanced approach to protect the health of its employees proportional to the risks. However, to enable this, all health hazards related to the mining and processing of minerals must be identified and evaluated and the associated health risks assessed.

I thank everyone, who contributed to this study, and hope that his or her efforts may lead to a better understanding of the Occupational Health Risk Assessment process and its importance as the basis for any Occupational Health Programme.

C.J. Badenhorst

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I wish to dedicate this research project to my grandfather who passed away in 1996.

CENTRAL THEORETICAL STATEMENT

A need exists in the South African Mining Industry for a model, based on the requirements of the Mine Health and Safety Act (29/1996), to guide employers through the fundamentals of a suitable and sufficient assessment of health risks for employees developing their own approaches.

ABSTRACT

In the South African Mining Industry the Legislator has recognised the need to identify health hazards associated with any workplace or process and to assess the associated risks (Leon, 1994). Neither the Mine Health and Safety Act (29/1996) and its Regulations, nor the Occupational Health and Safety Act (85/1993) and its Regulations, prescribe a specific format for the systematic and holistic approach to conduct occupational health risk assessments, but do prescribe some critical matters that should be addressed within an occupational health risk assessment.

The need for a systematic, holistic approach for conducting an occupational health risk assessment is discussed by Smith (1999) in his article, Mine Occupational Health and Safety - towards a holistic solution. The article highlighted that a core concept arising from the Mine Health and Safety Act is the need to address occupational health issues from a systematic perspective that encompasses all aspects of the interaction of employees with the work environment.

Guidelines for conducting occupational health risk assessments, as per legal requirement are limited in the mining industry. The absence of any specific model or guide usually results in the non-adherence or ignoring of the principles of occupational health, and that the principles of the occupational health risk assessment process are not explained to those developing their own approaches. The mining industry is also not aware of or focused on the key ingredients of an occupational health risk assessment and some of the potential pitfalls.

The objective of the study was to research the principles of the occupational health risk assessment process. To develop and evaluate a holistic occupational health risk assessment model for the South African Mining Industry, based on the basic principles of occupational health and the legislative requirement for occupational health risk assessments. This will not only guide persons through conducting an occupational health risk assessment, but will also simplify the occupational health risk assessment process. However, still delivering scientifically sound assessment records to ensure an adequate base for the development of all other occupational health systems and programmes.

The focus of the study was the Mine Health and Safety Act (29/1996) and its Regulations, with specific focus on Regulation 9 of the Act. The requirements set by this piece of legislation for conducting an occupational health risk assessment were studied in detail. Similar requirements for the South African Industry (other than mining) by the Occupational Health and Safety Act (85/1993), and specifically by the Hazardous Chemical Substances Regulations, Asbestos Regulations and Lead Regulations of the Act, were also studied. A comparison was drawn between the requirements of all these Regulations. International legislation and best practices on conducting occupational health risk assessments were also researched and compared to South African legislation and best practices.

A set of key elements (minimum components) for a comprehensive occupational health risk assessment process were identified. With the set of key elements identified, an audit protocol to evaluate current occupational health risk assessment processes (including procedures, systems and strategies) within the South African Mining Industry were developed. Audits were conducted and trends analysed to identify shortcomings in current applied occupational health risk assessment processes.

Results from the study indicate that at present, occupational health risks are not properly quantified. A number of potential health hazards such as vibration, radiation (ionising and non-ionising radiation), ergonomics, psychological and biological stressors are in general excluded from current occupational health risk assessment scopes. Occupational hygiene measurement results and results from medical surveillance (when available) are seldom considered or used as information for the occupational health risk assessment or as part of the review of occupational health risk assessments.

Sources of health hazards and risks are not properly identified, controlled and communicated to employers and employees. Interaction with employee representatives via the Health and Safety Committees or Representatives during the planning and conductance phases of the occupational health risk assessment process is limited. More than often the conductance of occupational health risk assessments is the responsibility of a single person without the use of "assessment teams". Consultation with the Health and Safety Committee / Representative before measures are determined to address identified health risks is absent in most cases. The outcome of occupational health risk assessments is not used to compile area risk profiles, man-job specifications or as a basis for occupational hygiene monitoring strategies, risk based medical surveillance or training on health hazards present in the workplace. These form the basis for the development of an occupational health programme and the absence of these could result in improper risk management and would negatively impact on the health status of the employees.

The findings of the study confirm the central theoretical statement of the research project, i.e. that a need exists in the South African Mining Industry for a model, based on the requirements of the Mine Health and Safety Act (29/1996) and other best practices, to guide employers through the fundamentals of a suitable and sufficient assessment of health risks.

Although a large amount of risk assessment models are available of which some were analysed as part of the study, only a few of these models are occupational health specific, of which even fewer are mining specific or prescribe a specific format for a systematic and holistic approach to conduct occupational health risk assessments, in line with the requirements set by the Mine Health and Safety Act (29/1996) for the conductance and contents of an occupational health risk assessment.

An occupational health risk assessment model, guidelines and templates were developed and tested through comprehensive occupational health risk assessments conducted at

three different workplaces. The holistic model for the occupational health risk assessment process was evaluated against the requirements of the Mine Health and Safety Act (29/1996) and the ability of the model to guide employers through suitable and sufficient assessments of the health risks.

It was proven that a holistic approach, as proposed by the research model, should be followed when conducting an occupational health risk assessment. One should visualise the occupational health risk assessment as the first step in a constantly reviewed occupational health management programme. In fact, an occupational health risk assessment should be the cornerstone for the development of all other occupational health systems and programmes.

AFRIKAANSE TITEL

“Beroepsgesondheid risiko beraming: ‘n oorsig en model om die Suid Afrikaanse Myn Industrie te lei na ‘n holistiese oplossing”.

OPSOMMING

In die Suid Afrikaanse mynindustrie het die Wetgewer die behoefte geïdentifiseer om gesondheidsgevaare wat met enige werksplek of proses geassosieer word, te identifiseer en die geassosieerde gesondheidsrisiko's te bepaal (Leon, 1994). Nie die Wet op Myn Gesondheid en Veiligheid (29/1996) of die Regulasies van die Wet of die Wet op Beroepsgesondheid en Veiligheid (85/1993) of die Regulasies van die Wet beskryf ‘n spesifieke formaat vir ‘n sistematiese en holistiese benadering vir beroepsgesondheid risiko beramings nie, alhoewel wetgewing sekere kritiese aangeleenthede vereis wat wel in ‘n beroepsgesondheid risiko beraming vervat moet wees.

Die behoefte vir ‘n sistematiese, holistiese benadering tot beroepsgesondheid risiko beramings word geadresseer deur Smith (1999) in sy artikel “Mine Occupational Health and Safety – towards a holistic solution”. Die artikel benadruk die feit dat ‘n kern konsep van die Wet op Myn Gesondheid en Veiligheid (29/1996) die vereiste is om beroepsgesondheids probleme vanuit ‘n sistematiese perspektief te adresseer wat alle aspekte van die interaksie tussen werkers en die werksplek sal insluit.

Riglyne vir beroepsgesondheid risiko beramings soos wetlik vereis, is beperk in die Suid Afrikaanse mynindustrie. Die afwesigheid van definitiewe modelle of riglyne veroorsaak die verbreking en ignorering van die beginsels van beroepsgesondheid. Verder word die beginsels van die beroepsgesondheid risiko beramings proses nie verduidelik aan diegene wat hulle eie benaderings wil ontwikkel nie. Diegene is dus ook nie bewus van die hoof komponente van ‘n beroepsgesondheid risiko beraming of die potensiële slaggate nie.

Die doelwit van die studie was om die beginsels van die beroepsgesondheid risiko beramings proses te bestudeer. Om ‘n model vir ‘n holistiese beroepsgesondheid risiko beraming, gebaseer op die basiese beginsels van beroepsgesondheid en die wetlike voorskrifte vir beroepsgesondheid risiko beramings, vir die Suid Afrikaanse mynindustrie te ontwikkel en te evalueer.

Die model sal nie alleenlik dien as ‘n gids vir persone wat beroepsgesondheid risiko beramings onderneem nie, maar sal ook die beroepsgesondheid risiko beramings proses vereenvoudig, maar nog steeds wetenskaplik korrekte beroepsgesondheid risiko

beramings verslae lewer en verseker dat 'n geskikte basis geskep word vir die ontwikkeling van enige verdere beroepsgesondheidsisteme en -programme.

Die fokuspunt van die studie was die Wet op Myn Gesondheid en Veiligheid (29/1996) en die Regulasies van die Wet, spesifiek Regulasie 9 van die Wet. Die vereistes wat gestel word vir beroepsgesondheid risiko beramings deur hierdie spesifieke gedeelte van die Wet is bestudeer en geanaliseer. Soortgelyke vereistes vir die Suid Afrikaanse Industrie (uitsluitend myne) wat deur die Wet op Beroepsgesondheid en Veiligheid (85/1993) en dan spesifiek deur die Gevaarlike Chemiese Substansies Regulasie, die Asbes Regulasie en die Lood Regulasie van die Wet gestel word, is bestudeer en geanaliseer. 'n Vergelyking is getref tussen die verskeie vereistes en voorskrifte van die bogenoemde wetgewings en hulle Regulasies. Internasionale wetgewing en voorskrifte vir beroepsgesondheid risiko beramings is ook nagevors en vergelyk met Suid Afrikaanse wetgewing, voorskrifte en algemene gebruiks praktyke.

'n Stel sleutel elemente (minimum komponente) vir 'n omvattende beroepsgesondheid risiko beramings proses is geïdentifiseer. Die elemente is gebruik om 'n ouditprotokol te ontwikkel om huidige beroepsgesondheid risiko beramings prosesse in die Suid Afrikaanse mynindustrie te evalueer. Oudits is gedoen en tendensies is geanaliseer om tekortkominge in huidige toegepaste beroepsgesondheid risiko beramings prosesse te identifiseer.

Resultate van die studie het getoon dat beroepsgesondheidsrisiko's nie na behore gekwantifiseer word nie. 'n Aantal potensiële gesondheidsgehare soos vibrasie, radiasie (ioniserend en nie-ioniserend), ergonomiese, psigologiese en biologiese stressors word in die algemeen uitgesluit van beroepsgesondheid risiko beramings. Resultate van beroepshigiëne metings asook resultate van mediese waarnemings (waar beskikbaar) word selde inaggeneem, of gebruik as inligting vir 'n beroepsgesondheid risiko beraming of as deel van die hersiening van 'n beraming.

Bronne van gesondheidsgehare of -risiko's word nie na behore geïdentifiseer, beheer en gekommunikeer na werkgewers of werkers toe nie. Interaksie met werknemer verteenwoordigers, bevoorbeeld die Gesondheids en Veiligheidskommittees of Gesondheids en Veiligheidsverteenvoordigers, tydens die beplannings- en uitvoeringsfases van beroepsgesondheid risiko beramings is beperk en onvoldoende. In baie gevalle is die uitvoering van beroepsgesondheid risiko beramings die verantwoordelikheid van 'n enkele persoon in pleks daarvan om gebruik te maak van 'n risiko bepalings span. Konsultasie met Gesondheids en Veiligheidskommittees of Gesondheids en Veiligheidsverteenvoordigers alvorens beheermaatreëls om geïdentifiseerde gesondheidsgehare en risikos te adresseer is in meeste gevalle afwesig. Die bevindings van beroepsgesondheid risiko beramings word nie aangewend vir die samestelling van area-risiko profile nie, ook nie vir die samestelling van persoon-taak spesifikasies nie. Dit word ook nie aangewend as die basis vir risiko gebaseerde mediese waarneming nie.

Genoemde elemente vorm die basis vir die ontwikkeling van 'n beroepsgesondheid program en die afwesigheid daarvan, kan aanleiding gee tot ontoepaslike risiko bestuur en kan 'n negatiewe impak hê op die gesondheid van werkers.

Die bevindings van die studie bevestig die hipotese van die navorsingsprojek naamlik dat daar 'n behoefte bestaan in die Suid Afrikaanse mynindustrie vir 'n model, gebaseer op die voorskrifte van die Wet op Myn Gesondheid en Veiligheid (29/1996) en ander aanvaarbare praktyke om werkgewers te lei deur die fundamentele beginsels van 'n toepaslike en voldoende beroepsgesondheid risiko beraming.

Alhoewel 'n aantal risiko beramingsmodelle beskikbaar is in die literatuur, waarvan sommige geanaliseer is as deel van die studie, is slegs 'n paar van die modelle beroepsgesondheid spesifiek, waarvan nog minder myn industrie spesifiek is. Die modelle beskryf verder ook nie 'n spesifieke formaat vir 'n sistematiese en holistiese benadering om beroepsgesondheid risiko beraming uittevoer nie.

'n Beroepsgesondheid risiko beramings model, riglyne en standaard formate is ontwikkel en getoets deur middel van volledige beroepsgesondheid risiko beramings in drie verskillende werksplekke. Die holistiese model vir beroepsgesondheid risiko beramings is ge-evalueer teenoor die vereistes wat die Wet op Myn Gesondheid en Veiligheid (29/1996) stel vir sulke beramings en die vermoë van die model om werkgewers te lei deur toepaslike en volledige beramings van gesondheidsrisikos.

Dit is bewys dat 'n holistiese benadering, soos voorgestel deur die nagevorste model, gevolg moet word tydens die uitvoer van 'n beroepsgesondheid risiko beraming. Die persoon wat die beraming doen moet dit visualiseer as die eerste stap van 'n voortdurende hersiende beroepsgesondheids bestuursprogram. Inteendeel, beroepsgesondheid risiko beraming moet die basis wees vir die ontwikkeling van enige ander beroepsgesondheid sisteem of -program.

CONTENTS

PREFACE.....	iii
ACKNOWLEDGEMENTS.....	iv
CENTRAL THEORETICAL STATEMENT.....	iv
ABSTRACT.....	v
AFRIKAANSE TITEL.....	viii
OPSOMMING.....	viii
LIST OF FIGURES.....	xvi
LIST OF TABLES.....	xvii
ABBREVIATIONS.....	xviii
DEFINITIONS.....	xx
CHAPTER 1: INTRODUCTION	
1.1 Background.....	1
CHAPTER 2: RESEARCH OBJECTIVE	
2.1 General objectives.....	2
2.2 Specific objective.....	2
2.3 Research method of the thesis.....	3
2.4 Research approach of the thesis.....	4
CHAPTER 3: LITERATURE APPRAISEL	
3.1 Introduction.....	5
3.2 The nature of risk.....	7

3.3 Occupational health hazard identification and risk assessment framework.....	8
3.3.1 Hazard identification.....	8
3.3.2 Dose-response assessment.....	8
3.3.3 Exposure assessment.....	9
3.3.4 Risk characterisation.....	9
3.4 Types of HIRA.....	12
3.4.1 Baseline HIRA.....	12
3.4.2 Issue-based HIRA.....	14
3.4.3 Continuous HIRA.....	14
3.4.4 Inter-relationship between types of HIRA.....	16
3.5 Risk management.....	17
3.5.1 Relationship between hazard identification, risk assessment and risk management.....	19
3.6 Risk characterisation.....	21
3.6.1 Risk assessment matrices.....	21
3.6.2 Qualitative risk evaluation.....	22
3.6.3 Semi quantitative evaluation.....	23
3.6.4 Quantitative evaluation.....	26
3.7 Control strategies.....	31
3.7.1 Hierarchy of control.....	33
3.8 Recording of the occupational health risk assessment.....	35
3.9 Occupational health risk communication.....	35
3.9.1 Employee's right to information.....	38
3.9.2 Seven cardinal rules of risk communication.....	39
3.10 Occupational health risk assessment review.....	39
3.11 Occupational health risk assessment deliverables.....	40
3.11.1 Occupational health policy.....	41
3.11.2 Occupational health procedures.....	42
3.11.3 Occupational hygiene exposure monitoring strategy.....	42
3.11.4 Guideline for risk based medical surveillance.....	45
3.11.5 Guidelines for education, training and awareness.....	47

3.11.6 Occupational health risk profile.....	48
3.11.7 Guidelines for Functional Work Capacity and Fitness to Perform Work.....	52
3.11.8 Occupational health risk assessment with specific reference to Physical Work Capacity (PWC) and Functional Work Capacity (FWC).....	54
3.12 Occupational health and safety management systems.....	56
3.13 Occupational health management.....	57
3.14 Occupational Health and Safety Assessment series (OHSAS 18001).....	58
3.14.1 The planning phase of OHSAS 18001 and risk assessment.....	59
3.14.2 Planning for hazard identification, risk assessment and risk control.....	60
3.14.3 Typical inputs.....	62
3.14.4 Process.....	62
3.15 Integrated management systems.....	65

CHAPTER 4: OCCUPATIONAL HEALTH RISK ASSESSMENT (OHRA) PROCESSES

4.1 Occupational health risk assessment – South African background...	67
4.2 Comparison between different occupational health risk assessment processes.....	69
4.3 South Africa's Mine Health and Safety Act.....	70
4.4 SIMRAC Practical Guide to the Risk Assessment Process.....	71
4.5 South Africa's Occupational Health and Safety Act.....	75
4.5.1 Hazardous Chemical Substances Regulations.....	75
4.5.2 Asbestos Regulations.....	76
4.5.3 Lead Regulations.....	77
4.6 SAIOH Guide to Conducting an Occupational Health Risk Assessment.....	79
4.7 National Institute for Occupational Safety and Health (NIOSH) USA ..	81

4.8 National Occupational Health and Safety Commission (NOHSC) – Australia.....	83
4.9 Health and Safety Executive (HSE) – United Kingdom.....	87
4.10 Occupational Safety and Health Service of the Department of Labour – New Zealand.....	91
4.11 Occupational Safety and Health Branch of the Labour Department of Hong Kong.....	97
4.12 Identified key elements of the occupational health risk assessment process.....	101

CHAPTER 5: CURRENT STATUS OF OHRA SYSTEMS IN THE SOUTH AFRICAN MINING INDUSTRY

5.1 Key elements of the occupational health risk assessment process.....	113
5.2 Development of the audit protocol.....	113
5.3 Research methodology.....	114
5.4 Sample frame.....	115
5.5 Analysis.....	115
5.6 Results.....	115
5.7 Findings.....	128
5.8 Conclusions.....	129

CHAPTER 6: RESEARCH MODEL

6.1 Introduction.....	131
6.2 Holistic model for the occupational health risk assessment process.....	131
6.2.1 Phase 1.....	133
6.2.2 Phase 2.....	133

6.2.3 Phase 3.....	135
6.2.4 Phase 4.....	136
6.2.5 Phase 5.....	137
6.2.6 Phase 6.....	139
6.2.7 Phase 7.....	142
6.2.8 Phase 8.....	146
6.2.9 Phase 9.....	147
6.3 Holistic model support documents.....	148
6.4 Occupational health risk assessment model evaluation.....	148
6.5 Findings of the model evaluations.....	153
6.6 Findings of the document template evaluations.....	157

CHAPTER 7: CONCLUSION

Conclusion.....	159
References.....	161

Appendix A – OHRA audit protocol

Appendix B – OHRA worksheet

Appendix C – OHRA report template

Appendix D – Person-job specification template

Appendix E – OHRA record for risk-based medical surveillance

Appendix F – OHRA: Stoping production section of a conventional hard rock mine

Appendix G – OHRA: Furnace production section of a platinum smelter

Appendix H – OHRA: Underground diesel workshop

LIST OF FIGURES

2.1	The research approach of the thesis.....	4
3.1	Elements of the National Academy of Science risk assessment model.....	10
3.2	The health risk assessment process model.....	11
3.3	Baseline HIRA process as proposed by the SA Chamber of Mines.....	13
3.4	Issue-based HIRA process as proposed by the SA Chamber of Mines.....	15
3.5	Inter-relationship between different types of risk assessment processes...	17
3.6	Risk management model.....	19
3.7	The risk management process.....	20
3.8	Model for risk assessment and management.....	21
3.9	Semi-quantitative risk evaluation.....	26
3.10	Quantitative risk rating.....	26
3.11	Calculation of the occupational health rating	27
3.12	The dose effect relationship.....	28
3.13	Emission control model.....	33
3.14	Hierarchy of controls.....	34
3.15	Relationship between OHRA and other relevant programmes.....	40
3.16	Risk assessment and monitoring flow diagram.....	44
3.17	Example of an occupational health risk profile.....	49
3.18	An element (restricted workplace) from the FWC test battery.....	55
3.19	OHSAS 18001 process.....	59
4.1	The risk assessment process – SIMRAC.....	75
4.2	The occupational health risk assessment process – SAIOH.....	79
4.3	Overview of the assessment process and follow-up.....	93
4.4	Five steps to risk assessment (Hong Kong, Department of Labour, 2006).....	99
5.1	Graph reflecting the results of a comparison between the status of the ten (10) groups of the significant elements of the OHRA process at twelve (12) operations.....	123
5.2	Graph reflecting the elements of assessed OHRA processes with II rating values below the midpoint of 1.5.....	125
5.3	Graph reflecting the comparison between the element components of assessed OHRA processes with the ten highest and the ten lowest II rating values.....	127
6.1	The holistic model for the OHRA process.....	132
6.2	A typical dose-response curve.....	138
6.3	Diagramme of the OHRA support document templates.....	148

LIST OF TABLES

3.1	Qualitative risk evaluation after British Standard 8800.....	22
3.2	Action for risk levels after British Standard 8800.....	23
3.3	Semi-qualitative risk evaluation.....	24
3.4	Risk rating and risk management.....	24
3.5	Semi-qualitative risk evaluation.....	25
3.6	Quantitative risk evaluation.....	27
3.7	Criteria for tolerability of risk.....	27
3.8	Risk factors.....	28
3.9	Risk classification.....	29
3.10	Classification of airborne pollutants (excluding toxic gases and vapours)...	29
3.11	Classification of toxic gases and vapours.....	30
3.12	Classification of noise.....	30
3.13	Classification of thermal stress – heat.....	31
3.14	Classification of thermal stress – cold.....	31
3.15	A stepwise approach for developing a risk based medical surveillance Programme.....	46
4.1	Summary of the Health and Safety Executive's guide for risk assessment..	90
4.2	Key elements of the OHRA processes.....	101
5.1	The status of ten (10) groupings of significant elements of assessed OHRA system.....	117
5.2	A comparison between the status of the ten (10) groups of the significant elements of the OHRA process at twelve (12) operations.....	123
5.3	Elements of assessed OHRA processes with II rating values below the midpoint of 1.5.....	124
5.4	Comparison between the element components of assessed OHRA processes with the ten highest and the ten lowest II rating values.....	126
6.1	Occupational health risk matrix.....	141
6.2	Risk classification.....	142

ABBREVIATIONS

The following abbreviations were used in the text, listed alphabetically.

- DME - Department of Minerals and Energy (South Africa)
- FWC - Functional Work Capacity
- HEG - Homogeneous Exposure Group
- HIRA - Hazard Identification and Risk Assessment
- HSE - Health and Safety Executive (United Kingdom)
- HTS - Heat Tolerance Screening
- IOHSA - Institute of Occupational Hygienist of South Africa
- MHSA - Mine Health and Safety Act (South Africa)
- MSDS - Material Safety Data Sheet
- MRAC - Mining Regulations Advisory Council
- NOHSC - National Occupational Health and Safety Commission (Australia)
- Nedlac - National Economic Development and Labour Council
- NIOSH - National Institute of Occupational Safety and Health (USA)
- OEL - Occupational Exposure Limit
- OESSM - Occupational Exposure Sampling Strategy Manual
- OHRA - Occupational Health Risk Assessment
- OHS Act - Occupational Health and Safety Act (South Africa)
- OH&S - Occupational Health and Safety
- OS&HS-NZ - Occupational Safety and Health Services of the Department of Labour – New Zealand

- OS&HB-HK - Occupational Safety and Health Branch of the Labour
Department of Hong Kong
- PPE - Personal Protective Equipment
- RA - Risk assessment
- SAIOH - Southern African Institute for Occupational Hygiene
- SHE - Safety, Health and Environment
- TWA - Time Weighted Average

DEFINITIONS

Biological monitoring: A planned programme of periodic collection and analyses of body fluid, tissues, excreta or exhaled air in order to detect and quantify the exposure to or absorption of any substance or organism.

Document (noun): Written, electronic, or photographic information such as a procedure or record.

Documented (verb, adjective): Substantiated through the use of documents.

Dose-response assessment: the basis for determining or predicting health effects of substances at specific doses.

Employee: A person who is employed by the organisation or by a contractor to the organisation when that person is under the day-to-day control of the organisation.

Employee Representative: An employee of the organisation authorised by other employees to represent them (1) through a union representing the interests of employees in accordance with the provision of national laws and regulations or collective bargaining agreements or (2) through any other selection process allowed by law.

Exposure: Contact with or proximity to a hazard, taking into account duration and intensity.

Exposure assessment: the presence of a hazard does not imply that an individual has been exposed since exposure is dependant on the emission, dispersal and ultimately type of contact with workers.

Frequency/likelihood: Chance per unit time, (usually per year): Exposure x probability.

Harm: Injuries, occupational diseases or losses

Hazard: A condition, set of circumstances, or inherent property of substances or environmental factors that can cause injury, illness or death.

Hazard identification: Process of recognition that a hazard exists and defining its characteristics.

Incident: An unsafe occurrence that did not give rise to but had the potential to lead to an illness or injury.

Medical surveillance: A planned programme of periodic examination, which may include clinical examinations, biological monitoring, or medical testing of employees by an occupational health practitioner or an occupational medical practitioner.

Occupational Health and Safety Management System: A set of interrelated elements that establish and/or support occupational health and safety policy and objectives, and mechanisms to achieve those objectives in order to continually improve occupational health and safety.

Occupational Hygiene: The anticipation, recognition, evaluation and control of conditions at a workplace that may cause illness or adverse effects to persons.

Probability: Chance that a person or persons will be harmed during the exposure period.

Qualitative: observations or information characterised by measurement on a categorical scale (i.e. dichotomous or nominal scale) or, if the categories are ordered, an ordinal scale e.g. “low”, “medium” and “high”.

Quantitative: data in numerical quantities such as continuous measurements or counts e.g. percentile, rates, etc.

Record: A document showing or stating results achieved or providing information or data of activities performed.

Risk: An estimate of the combination of the likelihood or probability and time exposure of an occurrence of a hazardous effect or exposure(s), and the severity of injury or illness that may be caused by the event or exposures.

Risk assessment: A structured approach for the identification and analysis, either qualitative or quantitative, of the likelihood of the occurrence of a hazardous event or exposure, and the severity of injury or illness that may be caused by it.

Risk characterisation: the estimation of the incidence and severity of the adverse health effect likely to occur due to actual or predicted exposure to a workplace hazard.

Risk rating: placing risk outcome in a rank or class in some form of prioritisation.

Semi-quantitative: a mixture of both mathematical and non-mathematical techniques.

Top management: Person or group of people who direct and control the operation of an organisation.

Worker: an individual who is an employee, or who undertakes working activities for any person who conducts a business or undertaking, regardless of the contractual arrangements in terms of which those working activities are performed.

Workplace: any premises or place where a worker or self-employed person works, will work or is likely to work.

CHAPTER 1: INTRODUCTION

1.1 Background

In the South African Mining Industry the Legislator has recognised the need to identify health hazards associated with any workplace or process and to assess the associated risks (Leon, 1994). Nor the Mine Health and Safety Act and its' Regulations nor the Occupational Health and Safety Act and its' Regulations prescribe a specific format for a systematic and holistic approach to conduct occupational health risk assessments. It do prescribe some critical issues that should be addressed within an occupational health risk assessment.

The need for a systematic, holistic approach for conducting occupational health risk assessment is addressed by Smith (1999) in his article, "Mine Occupational Health and Safety - towards a holistic solution". The article highlighted the need to address occupational health issues from a systematic perspective that encompasses all aspects of the interaction between employees and their work environment. Guidelines for conducting occupational health risk assessments as per legal requirement are non-existing in the mining industry.

The absence of any model or guide results either in non adherence to or disregard of the principles of occupational health and that the principles of occupational health are often not adhered to or ignored and that the principles of the occupational health risk assessment process are not explained to those developing their own approaches, and they are therefore also not aware of the key ingredients of an occupational health risk assessment and some of the potential pitfalls. Different approaches produce inevitably results which are difficult, if not impossible, to compare, and/or relate to..

The Southern African Institute for Occupational Hygiene (SAIOH), previously known as IOHSA (Institute of Occupational Hygiene of Southern Africa)) published a guideline, based on the United Kingdom HSE guideline, for conducting occupational health risk assessments (IOHSA, 1997) as required by the Occupational Health and Safety Act. This guide is based on the requirements of the Occupational Health and Safety Act, and not on the requirements of the Mine Health and Safety Act.

The application of the SAIOH Guide for use in the Mining Industry was researched. The SAIOH Guide addresses some key issues, but fail to address issues such as occupational health risk assessment communication and risk rating scales. As part of this study occupational health risk assessment communication was researched, while several risk rating models were compared.

Guidelines available on the subject of occupational health risk assessment fail in most cases to address health effects, especially physiological effects on the human body associated with excessive exposure to specific health hazards. To ensure comprehensive health risk assessments, ill health effects associated with excessive exposures must be included in the assessments. The availability of this information will

assist the employer to identify potential risks. Information on the severity of potential ill health effects also contributes to the risk evaluation process. Several literature sources are available and were used to include possible physiological effects associated with excessive exposure in the occupational health risk assessment model developed.

CHAPTER 2: RESEARCH OBJECTIVES

2.1 General objectives

The objective of the study (and the model as a product of the study) was to provide guidance to the South African Mining Industry on how to conduct a suitable and significant assessment of occupational health risks as required by Section 11(1) of the Mine Health and Safety Act (29/1996), based on internationally accepted best practices. The manner in which an occupational health risk assessment is carried out depends very much on its objectives and final use. In this case, the assessment has to be carried out with the purpose of satisfying the requirements of Section 11 of the Act. That is, the occupational health risk assessment shall be transparent and be recorded in accordance with Section 11(1)(c). The main purpose of the assessment is to enable mine managers to comply with the requirements of Section 11(2). The assessment must also “close the loop” to become a continuous process as required by Section 11(3)(a).

The objective, therefore, of this study was to explain, and to provide guidelines as to the identified inputs into the various management programmes and the principles of the occupational health risk assessment process. Also to ensure that those developing their own approaches are aware of the key ingredients and some potential pitfalls. It will emphasise the essential role of occupational health risk assessments to facilitate the drafting of occupational hygiene monitoring programmes, medical surveillance programmes and induction / training programmes, as well as creating a workforce that is sensitive to and aware of occupational health concerns and thus partake actively in such assessments.

2.2 Specific objectives

The specific objectives are to:

- research the principles of the occupational health risk assessment process;
- develop a model for the South Africa Mining Industry to assist in conducting suitable, sufficient and effective occupational health risk assessments;
- facilitate the drafting of an occupational hygiene monitoring programme, risk based medical surveillance programme and induction/awareness training programme.

The model and guide should assist the Mining Industry to produce occupational health risk assessments that were conducted thoroughly, combined with a scientific, systematic procedure, in an easy “user friendly” report format.

2.3 Research method

(also see 5.3, p.114)

The background of the study was the Mine Health and Safety Act (29/1996), and its Regulations, with specific focus on Regulation 9 of the Act. The requirements set by this piece of legislation for conducting an occupational health risk assessments were studied in detail. Similar requirements for the South Africa Industry (other than mining) by the Occupational Health and Safety Act (85/1993), and specifically by the Hazardous Chemical Substances Regulations, Asbestos Regulations and Lead Regulations of the Act, were also studied. A comparison was drawn between the requirements of these. International legislation and general practices (e.g. how, by whom, when, what, etc.) on conducting occupational health risk assessments were also researched and compared to South African legislation, guidelines and acceptable practices.

From the literature appraisal, a set of key elements (minimum required components) for a comprehensive occupational health risk assessment process were identified. With the set of key elements identified, an audit protocol to evaluate current occupational health risk assessment processes (including procedures, systems and strategies) within the South African Mining Industry was developed. Audits were conducted and trends analysed to identify shortcomings in current generally used occupational health risk assessment processes.

An occupational health risk assessment model, guidelines and templates were developed and tested through comprehensive occupational health risk assessments on three different workplaces. Results from the three occupational health risk assessments were used to evaluate the model, guidelines and templates against the set of key elements identified for a comprehensive occupational health risk assessment process.

In conclusion, the holistic model for the occupational health risk assessment process was evaluated against the requirements of the Mine Health and Safety Act and the ability of the model to guide employers through suitable and sufficient assessments of health risks.

2.4 Research approach

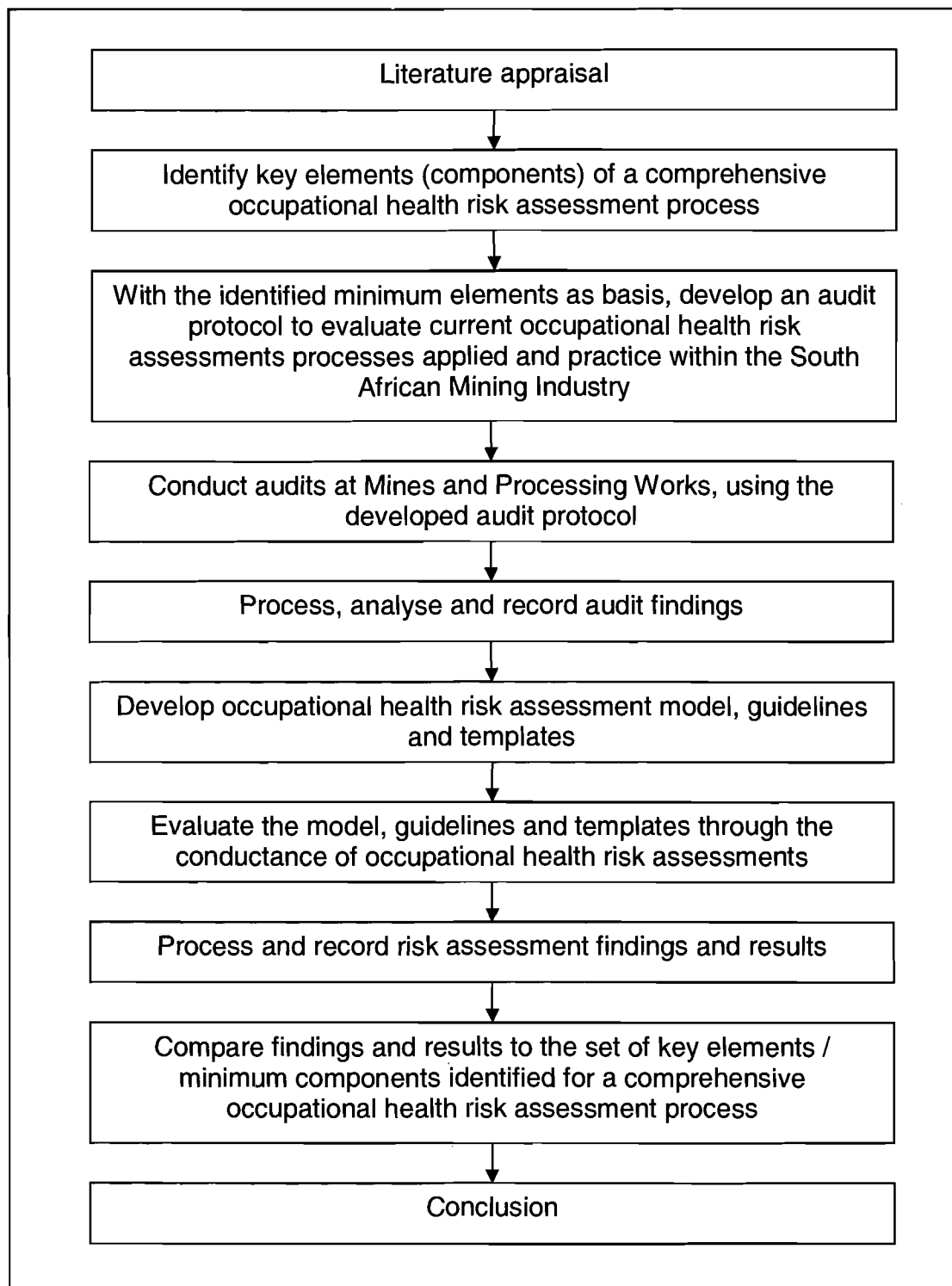


Figure 2.1. The research approach of the thesis.

CHAPTER 3: LITERATURE APPRAISAL

3.1 Introduction

From the earliest written records on human occupations, mining has been characterised as a dangerous trade with a high probability of injury, illness, or worse, death. This characterisation developed over thousands of years during which life was fragile for those who removed and processed ore. Regrettably, mining related accidents and illnesses were often viewed as the tragic costs of extracting the materials necessary for the development of modern life (Hethmon & Doane, 2001).

Today, mining is among the safest industries in the world as reflected by comparable industry fatality and injury rates. These improvements are the result of a number of factors, including improved mining methods, such as increased automation and other procedures, which have limited the interaction between man, machine, and mined material. Routine general education and specialised hazard and risk training for workers, broader understanding and application of health and safety management systems and techniques and greater recognition of the moral imperative to protect the industry's greatest asset – its' people.

Although these improvements are laudable, miners continue to be injured, develop occupational disease, and die on the job (Hethmon & Doane, 2001).

The fact that human loss continues in the industry also indicates that no single correct health and safety method and/or programme has been described and no absolute consensus has been established on a single correct health and safety risk control method. However, there are obvious predominant patterns in the types of activities conducted in almost all mines to safeguard miners and those who support them, such as contractors and vendors. These include, but are not limited to, mechanisms that identify, correct and prevent risks, educate and train personnel in hazard recognition, control and work practices and facilitate commitments and involvement.

In many mining companies, the term "safety" implies an organisational function that may include safety and occupational health and/or occupational hygiene. The primary focus of management today is on physical safety, or preventing negative, generally irreversible, events of acute duration. The outcomes of safety-related events are usually visible and can evoke strong emotions if the results are severe.

Occupational illnesses and diseases are primarily chronic and are generally characterised by temporary or permanent physical dysfunction. With the exception of some symptoms, they are not generally visible. Therefore, safety overrides health in mining because occupational illnesses take years to develop and management observes less physical trauma, if they witness anything at all. Despite this long-held bias, recognition for occupational health is now emerging. Experts now see that

occupational illness and disease do result in significant emotional and financial losses to workers, their families and communities, and their employers. Effective health and safety management must include acknowledging the importance of occupational health hazards and the proportionate application of resources to address those issues (Hethmon & Doane, 2001).

Occupational health comprises two principal elements (i) occupational hygiene and (ii) occupational medicine and these are enshrined in the South Africa Mine Health and Safety Act (29/1996).

The American Association of Industrial Hygienists (AAIH) defines industrial (occupational) hygiene as the science and art devoted to the recognition, evaluation and control of those environmental factors and stresses arising in or from the workplace which may cause sickness, impaired health and well-being or significant discomfort and inefficiency among workers or among the citizens of the community (Schoeman, 2003).

Occupational hygiene thus include the technical preventive measures to be taken at a workplace to protect the health of the workforce i.e. the recognition, evaluation and control of micro-environmental stressors such as dust, heat, hazardous chemical substances, etc.

The occupational hygienist will stress prevention and will therefore examine and evaluate the working environment by means of scientific observation and measurement to identify and quantify occupational health risks present in the working environment. The occupational hygienist will use the results obtained to employ engineering design techniques aimed at isolating each health hazard or reducing its risk to acceptable levels or, alternatively, protecting the worker.

Industrial (occupational) medicine is defined in the Encyclopaedia Britannica as that branch of medical science concerned with protecting workers from health hazards that may arise in their occupation and meeting health emergencies that may occur during the hours at work (Schoeman, 2003). Health emergencies refer to such incidences as asphyxiation, burns, or acute poisoning, which are dealt with prior to the patient being referred to a hospital or a family doctor. Occupational medicine deals with the health status of the employees potentially exposed to the micro-environmental stressors. Aspects such as pre-employment, pre-placement, periodic, special and exit medicals fall under the occupational medicine umbrella. Biological monitoring is an approach to estimating an individual's exposure in certain circumstances. It is a planned programme of periodic collection and analysis of body fluid, tissue, excreta or exhaled air in order to detect and quantify the exposure to or absorption of any substance or organism (Benjamin, 2001).

In the South African Mining Industry, the Legislator has recognised the need to identify health and safety hazards and assess the risk associated with every activity or process, as stipulated in Section 11 of the Mine Health and Safety Act (29/1996). Similar legislation can be found for the South African Industry in the Occupational Health and

Safety Act (85/1993). The Mine Health and Safety Act came into effect on 15 January 1997, replacing the Minerals Act (50/1991) as the legal basis for regulating occupational health and safety in South African mines.

Several key occupational health issues are central to this Act:

- health and safety are the joint responsibility of the employer, employee and state;
- employers and employees are required to identify hazards and minimize related risks;
- equipment manufacturers, suppliers and persons performing maintenance on equipment are responsible for the supply of “fit for purpose” equipment;
- routine measurement of risk exposure is crucial to the management of health and safety;
- health and safety training is essential to be able to assume responsibility for the identification and minimization of risks.

The main reasons why the duty to carry out assessments is explicitly included in the Mine Health and Safety Act (29/1996) is to ensure that the same, systematic approach is adopted for all work involving health hazards (whether in progress or to be started): identifying control measures which are correctly matched to the risk and to provide a basis for the effective and consistent communication of the information collected and the decisions reached to everyone who may need to know them at any time.

3.2 The nature of risk

It is of the utmost importance to understand precisely what is meant by the terms **hazard** and **risk**.

Hazard is the potential of a substance, situation, process etc. to cause harm.

Risk is the likelihood that harm (injury, disease, etc.) will be caused.

In order to understand the risk in a certain situation, it is necessary to understand the hazard and be able to estimate how often actual harm could occur (possibility of occurrence). This can be expressed mathematically as:

$$\text{risk} = \text{hazard} \times \text{probability}$$

The so-called, and very often used “no risk are acceptable” approach is therefore impossible (except by eliminating the whole activity). What is possible is to identify the hazards and take steps to reduce the associated risks. In other words, an unacceptable risk needs to be managed using the same management techniques as are used to manage other business activities. The process of risk assessment is fundamental to this approach.

3.3 Occupational health hazard identification and risk assessment framework

Risk can be broadly defined as the probability of occurrence and potential severity of some adverse event or outcome. Risk can be assessed in a number of ways, from highly quantitative measures using relatively refined data to calculate absolute risk, to qualitative means using the assessor's knowledge and experience to render a judgment regarding the risk. Risk assessment is the process of reducing the uncertainty associated with the probability of occurrence and potential severity of some adverse event or outcome. As such risk assessment can be used to predict the likelihood of many unwanted events, including industrial explosions, workplace injuries, failures of machine parts, natural catastrophes, injury or death from an array of voluntary activities, diseases, natural causes, life-styles or others.

The assessment of risks should include factors such as identification of potential hazards, exposure, measurement data, sources and frequency of exposure, types of measures used to control hazards, and potential severity of hazards. Assessing risks can be done using quantitative (numeric) or qualitative (descriptive) measures. (ANSI/AIHA Z10, 2005).

A quantitative occupational health risk assessment, however, is a separate, specific approach which uses toxicology data collected from animal studies and human epidemiology, combined with information about the degree of exposure, to quantitatively predict the likelihood that a particular adverse effect will be seen in a specific human population. With the emergence of quantitative methods, risk assessment models can better estimate the probability that a specific adverse effect will occur over a wide range of doses. Occupational health risk assessment is usually considered in terms of four components: hazard identification, dose-response assessment (hazard characterization), exposure assessment and risk characterisation.

The fundamental process of risk assessment is represented diagrammatically, in Figure 3.1.

3.3.1 Hazard identification

Hazard identification can be described as the process of determining whether exposure to particular substance or biological condition has the potential to cause human or environmental harm. Information is typically gathered through epidemiological studies, in vivo human and animal studies, which look at effects in living organisms, and in vitro studies, and computer modeling. One of the uncertainties associated with hazard identification is that scientists cannot always be sure that they have identified the potentially harmful substance. There are also uncertainties about the accuracy of animal studies, which are most often used to predict human health risks.

3.3.2 Dose-response assessment

Toxicological and epidemiological studies provide the basis for determining or predicting health effects of substances at specific doses. Dose-response assessments thus define the relationship between the dose of an agent and the probability of a

specific adverse effect (response). Dose-response models based on epidemiological studies offer the strongest evidence of a link between exposure to a substance and harm in humans.

3.3.3 Exposure assessment

The presence of a hazard does not imply that an individual has been exposed since exposure is dependant on the emission, dispersal and ultimately type of contact with workers. Exposure assessment quantifies the uptake of hazards from the environment by any combination of oral, inhalation and dermal routes of exposure. Exposure assessment is thus an estimate of the amount of a particular substance that comes into contact with the population at risk. Exposure is measured through personal and environmental monitoring. For example a personal exposure study could involve respirable dust exposure monitoring, biological monitoring such as testing the blood of someone for evidence of the presence of a certain chemical substance, etc. An environmental exposure study measures the amount of the substance in the environment, determines the route of exposure (inhalation, ingestion etc) and estimates how much of the substance comes into contact with the population. It is thus necessary to estimate the size of the population exposed, the rate at which the substance spreads in the environment and exposure of special populations.

3.3.4 Risk characterisation

Risk characterisation, the most important part of a health risk assessment, summarises and interprets the information collected from the three previous activities and identifies the limitations and the uncertainties in risk estimates. It is thus an estimate of risk to human health that combines the uncertainties from the first three steps to characterise the potential health and ecological effects, among individuals or populations, from exposure to hazardous materials and situations. Risk assessment provides the foundation for sound decision making around health and environmental issues and necessitates a delicate balance between economics, employee and public health, and environmental and regulatory compliance. Hazard identification, toxicity assessment (hazard characterisation), exposure assessment and risk characterisation are all important steps in the risk assessment process, however overall success is largely dependent on risk management and risk communication processes.

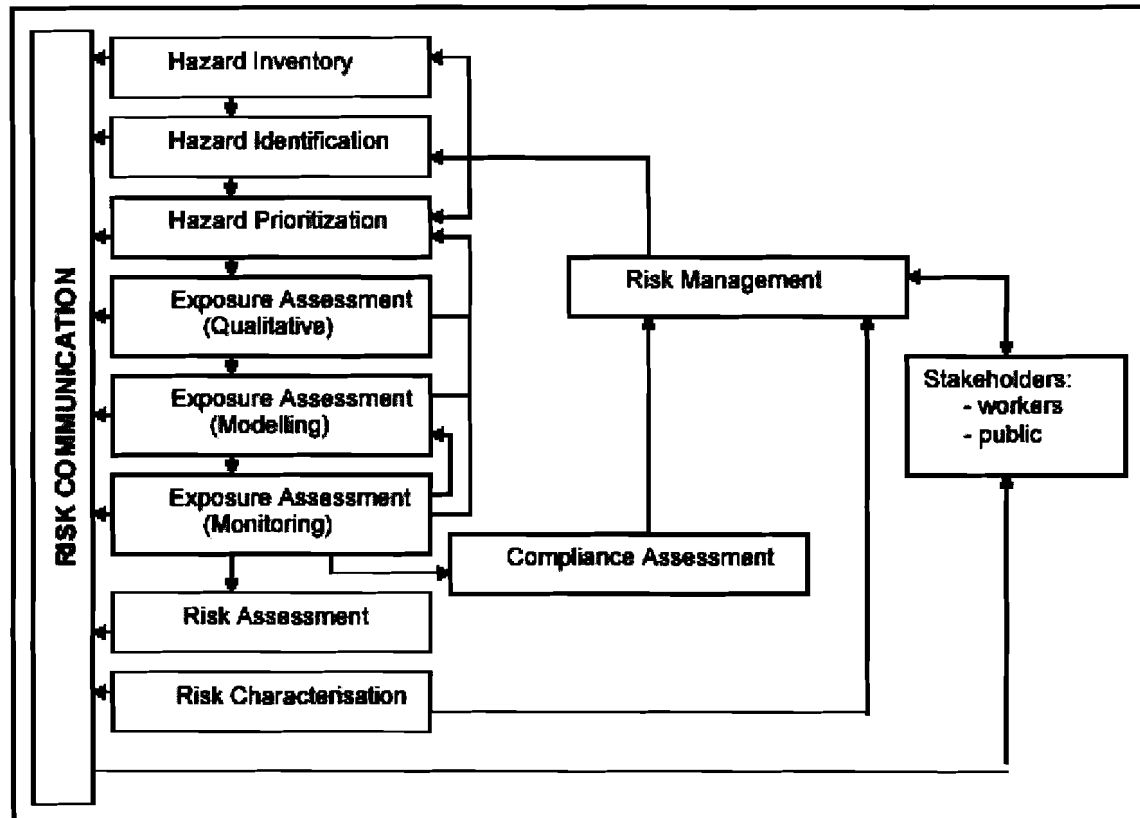


Figure 3.1. Elements of the National Academy of Science risk assessment model (Smith, 1999).

An occupational health risk assessment, as is required by Section 11 of the Mine Health and Safety Act (29/1996), is a systematic procedure to identify potential health hazards, evaluate the extent of risk, subjectively and/ or objectively, and to establish the need for, and the effectiveness of control measures (Schoeman, 1994). Furthermore the occupational health risk assessment is also intended to facilitate the drafting of occupational hygiene monitoring programmes, risk based medical surveillance programmes (Goede, 1998; Van Der Merwe, 1998) and occupational health education and awareness programmes (Schoeman, 2001).

The purpose of an occupational health risk assessment is to ensure that factors influencing health are fully understood and adequately quantified to enable a valid decision to be made about measures necessary to control health hazards arising from any workplace and/ or activity in a consistent and cost-effective manner. It also enables the employer to demonstrate readily, both to himself and to other persons, that all the factors pertinent to the activities have been considered, and that an informed and valid

judgment has been reached about the risk posed by the hazards, the steps which need to be taken to achieve and maintain adequate control, the need for monitoring exposure at the workplace and the need for medical surveillance and biological monitoring.

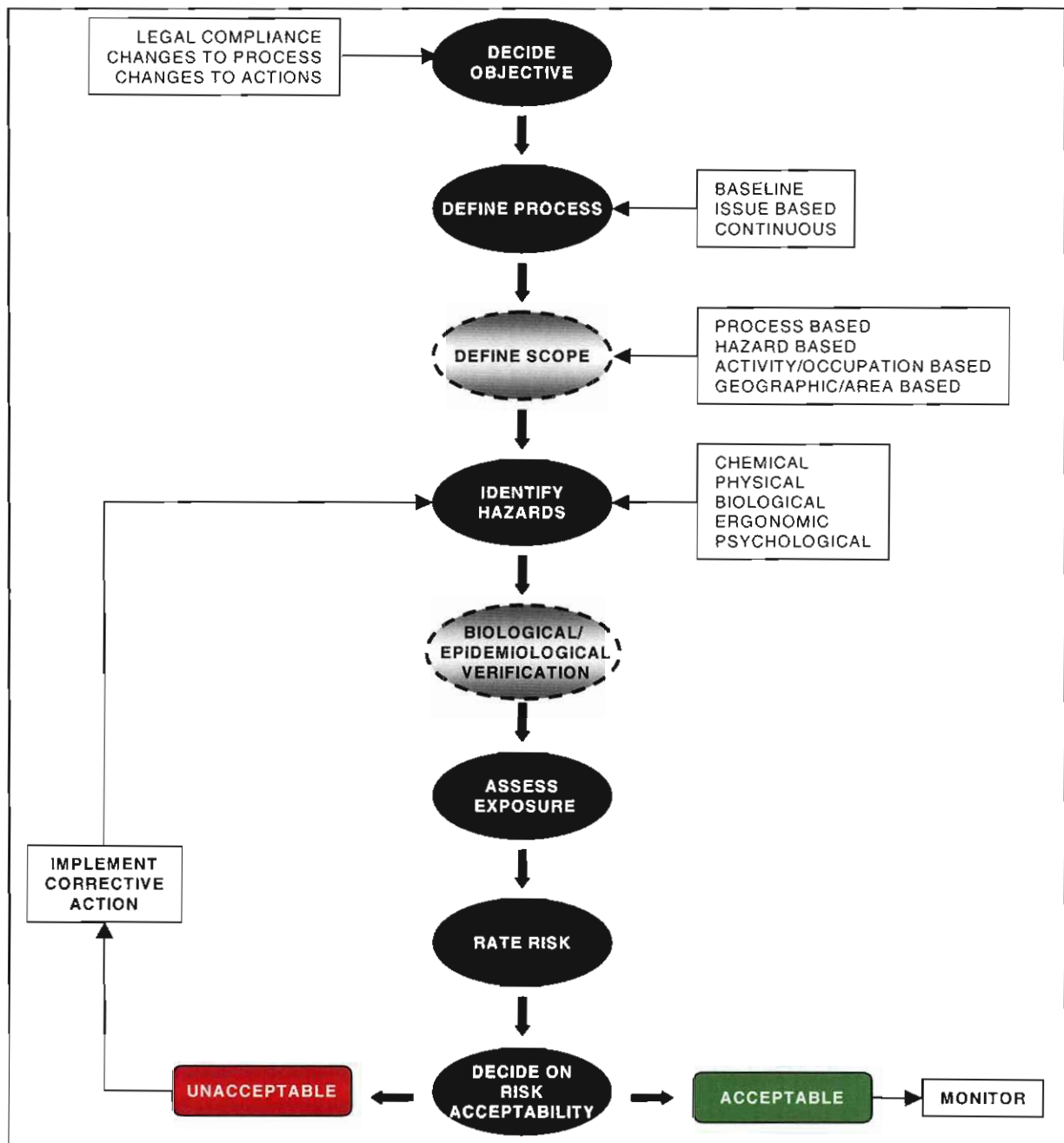


Figure 3.2. The health risk assessment process model (Guild & Marais, 2002).

There are no fixed rules about how the occupational health risk assessment process should be followed. However, there are some general principles that should be followed to ensure that the risk assessment is suitable and sufficient.

An occupational health risk assessment is deemed to be suitable and sufficient if:

- it has considered those risks which are likely to arise because of work and work activities;
- it has considered all people who might be affected;
- should enable the development and implementation of actions, and where appropriate, of systems to manage the risks;
- should be appropriate to the nature of the work being conducted;
- and will remain valid for a reasonable period of time; and
- precautions are reasonable, and the remaining risk is low.

(HSE, 2006; SAIOH, 2001).

This will enable the risk assessment process and the significant findings to be positive, i.e. to change the working environment through changing the working procedures or through the introduction of medium or long-term controls.

Almost all of the models referred to within the South African contexts prescribe some crucial matters that should be addressed within an occupational health risk assessment. This is however complicated by the subjective nature with which an occupational health risk assessment is conducted. The general complexity of these models, and the absence of specific step-by-step guidance, result in the principles of occupational health not being adhered to, or are ignored by those developing their own models and approaches.

3.4 Types of HIRA

There are three types of HIRA:

- Baseline;
- Issue-based; and
- Continuous.

The three types are inter-related and form an integral part of a management system. A brief description of each of the three types of HIRA is given below.

3.4.1 Baseline HIRA

Purpose

The purpose of a baseline HIRA (also referred to as the “first” or “bottom-line” risk assessment) is to determine the initial or first status of occupational health risk associated with a business.

Output

The output of a baseline HIRA is a set of risk profiles, which are used to prioritise both action programmes and issue-based risk assessments.

General Comments

Each mine or operation should decide on the set of risk profiles that are most appropriate for that mine or operation (e.g. risk profiles for all the geographical areas

and, within each geographical area, for activities, occupations and tasks), as per Figure 3.3. In selecting a set of risk profiles, care should be taken to ensure that all significant risks are identified. It is possible to overlook a significant risk if the risk profiles are not selected correctly.

The risks should be listed in order of significance. Figure 3.3 contains a schematic depiction of a possible process to arrive at various risk profiles.

The baseline HIRA should be reviewed on a needs driven basis, to support business planning and budgeting, or when circumstances could significantly change a risk profile.

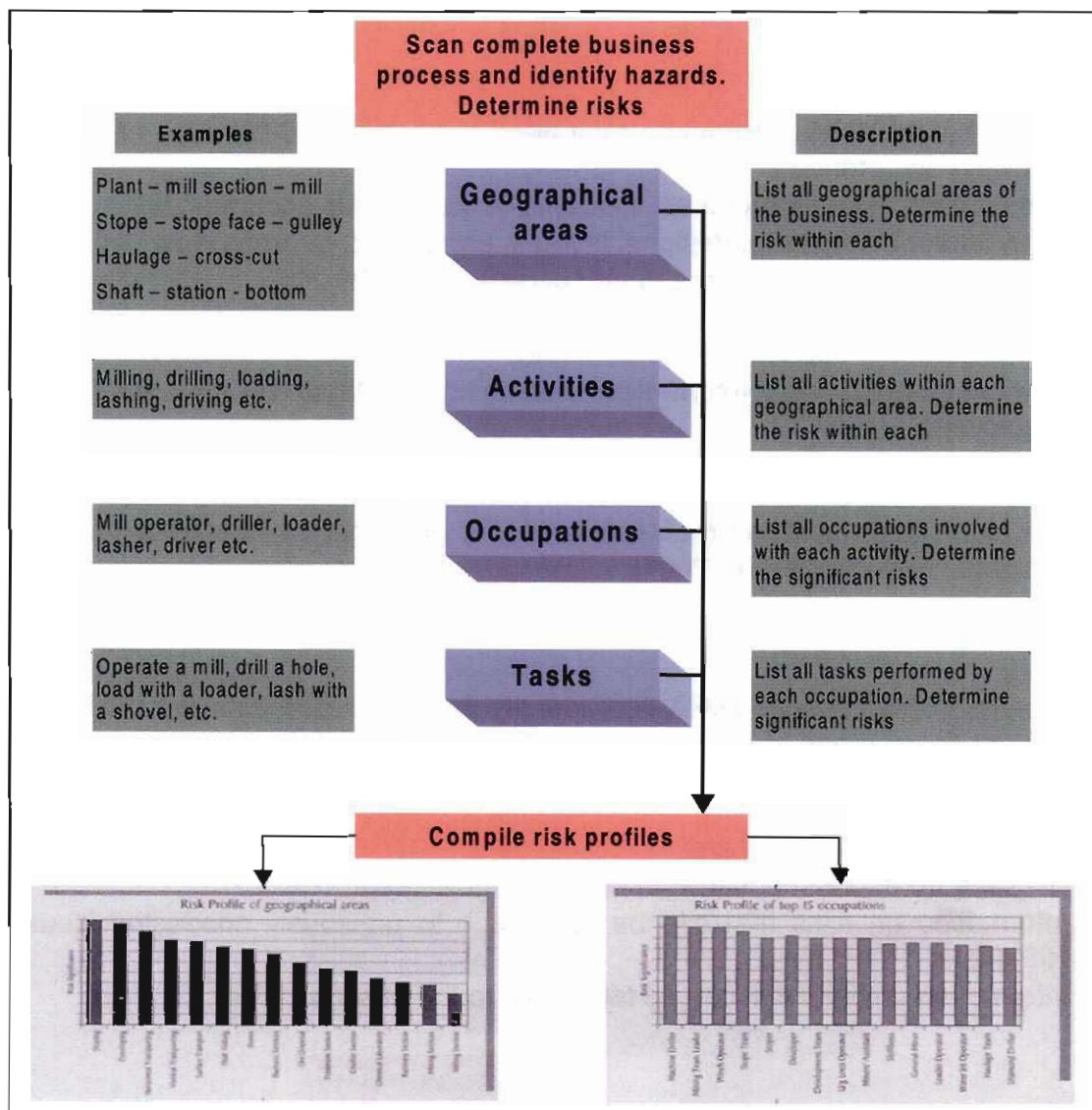


Figure 3.3. Baseline HIRA process as proposed by the SA Chamber of Mines (CoMofSA, 2001).

3.4.2 Issue-based HIRA

Purpose

The purpose of an issue-based HIRA is to conduct a detailed assessment study on a specific issue. This could be, for example, a detailed study on potential occupational exposure to asbestos, oil mist, etc.

Output

The output of an issue-based HIRA is clear recommendations to management for:

- input into continuous HIRA;
- action plans for the treatment of significant risk; and
- input into training programmes, standards, procedures, codes of practice and management system.

General Comments

The issue-based HIRA programme may need to be modified because of, for example, the following occurrences:

- cases of excessive exposures, incidents or “dangerous occurrences”;
- new, and/or changes to, designs, layouts, equipment, or processes, etc.;
- findings that come to the fore during continuous HIRA;
- requests from employees, regulators or members of affected stakeholder parties;
- a change in the baseline risk profile; and
- new knowledge and information becoming available on the level of risk to employees.

Figure 3.4 reflects a possible process to conduct an issue-based HIRA. There are various techniques (such as fault tree analysis, etc.) that can be used to conduct an issue-based HIRA (CoMofSA, 2001).

3.4.3 Continuous HIRA

Purpose

The purpose of continuous HIRA is to identify promptly occupational health and safety hazards for the purpose of immediately treating significant risks.

Output

Outputs of continuous HIRA are:

- risks are treated immediately, in order of significance;
- information on risks that can be feed back to previously conducted issue-based HIRA; and
- information on risks that can be feed back to the baseline HIRA.

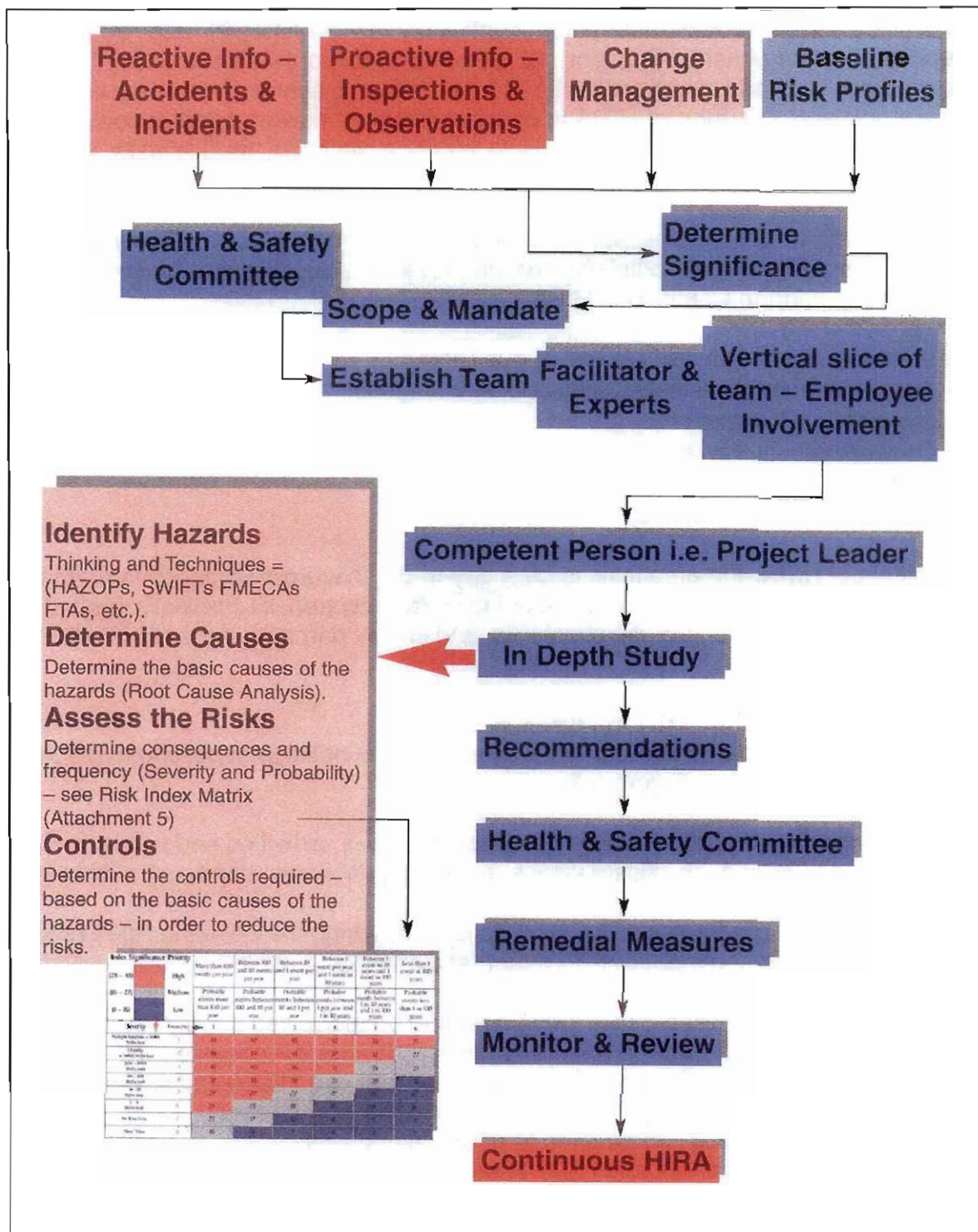


Figure 3.4. Issue-based HIRA process as proposed by the SA Chamber of Mines (CoMofSA, 2001).

General Comments

Continuous HIRA should take place continually as an integral part of day-to-day operational management. It might not use the more sophisticated HIRA techniques used in baseline and issue-based HIRA but, in terms of ensuring the reduction of risks in the workplace, this form of HIRA is possibly the most powerful and important. It is a “on the spot” evaluation with decisions to rectify a situation, reduce risks in order to prevent/minimize harm.

It is the duty of all first-line supervisors to ensure that effective Continuous HIRA actually take place in the workplace. An employer must ensure that all employees are competent to perform Continuous HIRA.

The following could form part of Continuous HIRA:

- occupational hygiene inspections and observations;
- occupational hygiene measurements;
- pre-work assessments;
- audits; and
- planned task observations.

In continuous HIRA, the emphasis is on a day-to-day hazard awareness through HIRA, and immediate risk treatment. In developing hazard awareness, memory joggers, such as inspection checklists, pre-use checklists, and critical part and paths checklists can be used.

3.4.4 Inter-relationship between types of HIRA

The inter-relationship between the three different types of HIRA is described below, and is set out schematically in Figure 3.5:

- (1) During the Baseline HIRA where geographical areas, activities and tasks are broken down and analysed, significant issues requiring immediate attention are closely monitored through the Continuous HIRA process;
- (2) Data from the Continuous HIRA process is used during the Baseline HIRA process;
- (3) Outcomes from Continuous HIRA might require more in-depth analysis through the Issue-based HIRA;
- (4) The outcome of an Issue-based HIRA needs to be monitored through the Continuous HIRA process to ensure recommendations are complied with and are effective. Checklists are normally produced as part of an Issue-based HIRA to be used in the Continuous HIRA as part of the monitoring process;
- (5) Baseline Risk Profiles can be used to prioritise and scope Issue-based HIRA;
- (6) As part of the continuous and issue-based HIRA, the integrity and effectiveness of management systems is evaluated;
- (7) The results from the complete risk management process manifest themselves in the baseline risk profiles (Guild & Marais, 2002).

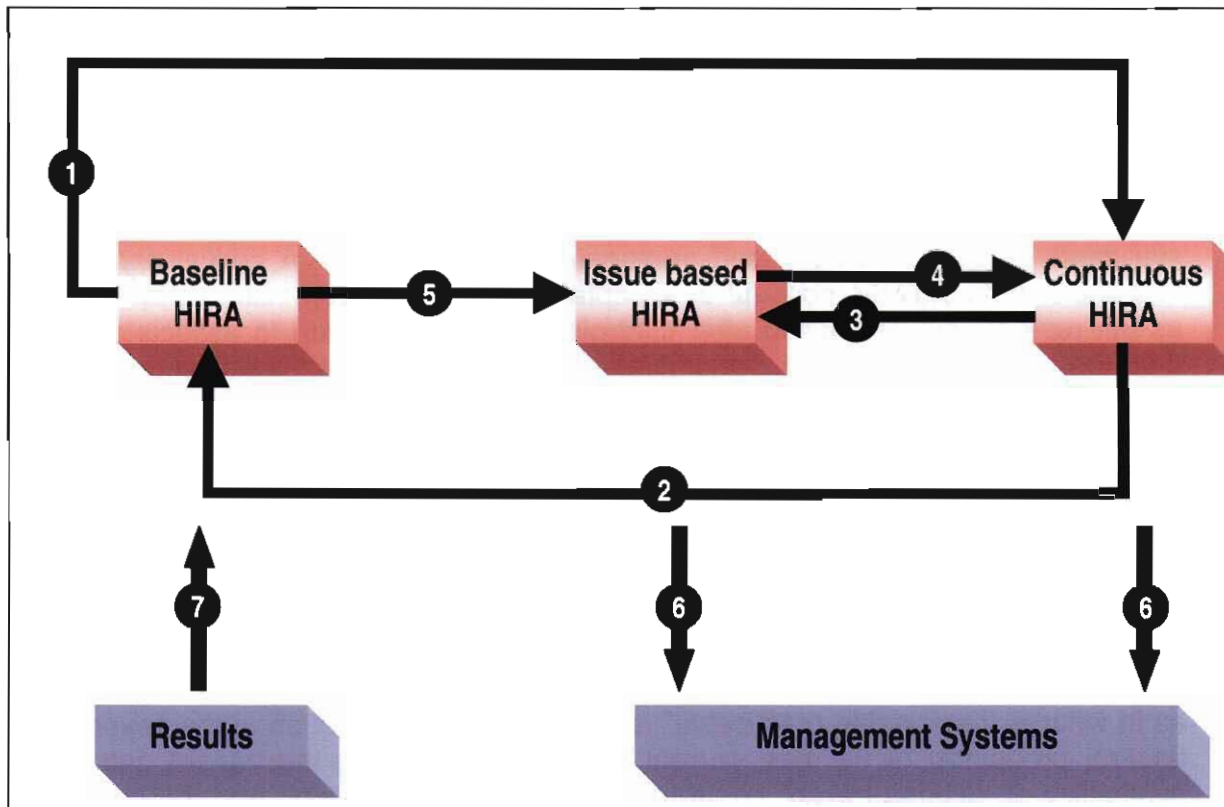


Figure 3.5. Inter-relationship between different risk assessment processes (Guild & Marais, 2002).

- as part of the Continuous and Issue-based HIRA processes, the integrity and effectiveness of the Management Systems is continually evaluated and up-dated to keep risks as low as is reasonably possible; and
- the results from the complete Risk Management Process manifest themselves in the Baseline Risk Profiles at the end of a given cycle. This can be used for comparison purposes against the Baseline Risk Profiles of previous cycles.

3.5 Risk management

Risk management is the process of integration of the results of the risk assessment with regulatory requirements and the cost and feasibility of remediation, as well as social and economic concerns. Identification of remediation goals based on established risk guidelines is an example of risk management in practice (Smith, 1999). Many employers have difficulty with the approach to occupational health legislation based on risk assessment. The assessment-based style of regulations requires employers to produce their own set of work procedures and systems, within a prescribed framework and meeting prescribed standards based on risk assessment. Employers have to address the health risks associated with their activities and consider the options available to deal with these risks. In fact, this is deregulation, both literally (in terms of

the number of regulations) and practically (very little is actually prohibited or prescribed under the health and safety regulations). It leaves the employer free to manage its own activities, provided they can demonstrate their commitment to the health of their employees and the public (Badenhorst et al. 2005; Benjamin, 2001).

Risk assessment, by its very nature, is a process whereby the magnitude of a specific risk is characterised so that decision makers can conclude whether an identified risk is sufficiently large enough to need management or regulation. A critical aspect of risk management is thus the concept of acceptable risk. Acceptable risk can be considered as the residual risk remaining after controls have been applied to associated hazards that have been identified, quantified to the maximum practicable, analysed, communicated to the proper level of management and accepted after proper evaluation. Acceptable risk must be defined by the organisation responsible and accountable for managing the risk (or controlling the risk). The determination that the risk of some adverse event or outcome is at an acceptable level should be made in light of an adequate assessment of the probability of occurrence and an understanding of the severity or cost of the outcome (in terms of injuries, illnesses, fatalities, property loss or lost productivity). Occupational health and safety regulations in essence establish minimum acceptable risk for the hazard and requires employers to take all "reasonable practicable" steps to protect the health of their employees at work. The legal judgment as to what is "reasonable practicable" is based on a consideration of the severity of the hazard, probability of the risk, current knowledge regarding the hazard and the risk, availability of suitable hazard control and/or elimination methods and the cost of such control/elimination method (Australian National University, 2001). Thus the legal test of "reasonable practicability" require employers to apply risk management principles, as shown in Figure 3.6, to control the hazards in their workplace to an acceptable level of risk.

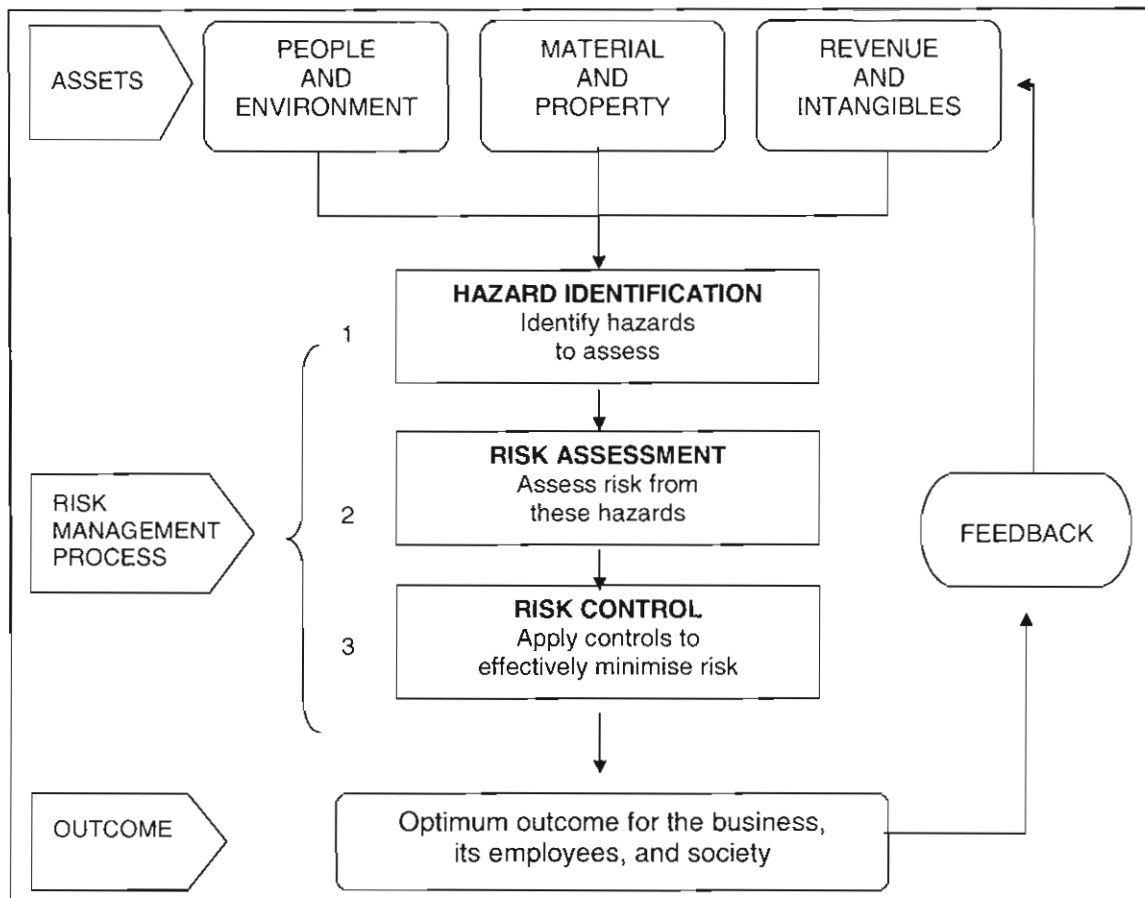


Figure 3.6. Risk Management Model (Australian National University, 2001).

Typically risk management plans are created to address specific hazards in the workplace are integrated into risk management systems in which policy and procedure are defined. In this way risk assessment and risk management are integrated into key business systems and processes.

3.5.1 Relationship between hazard identification and risk assessment and risk management

It is important to note that risk management and HIRA (Hazard Identification and Risk Assessment) are not synonymous, but that the latter forms part of a bigger, more comprehensive management approach.

The outcomes of the HIRA process are inputs for the risk treatment process, which forms part of the broader risk management process (Figure 3.7).

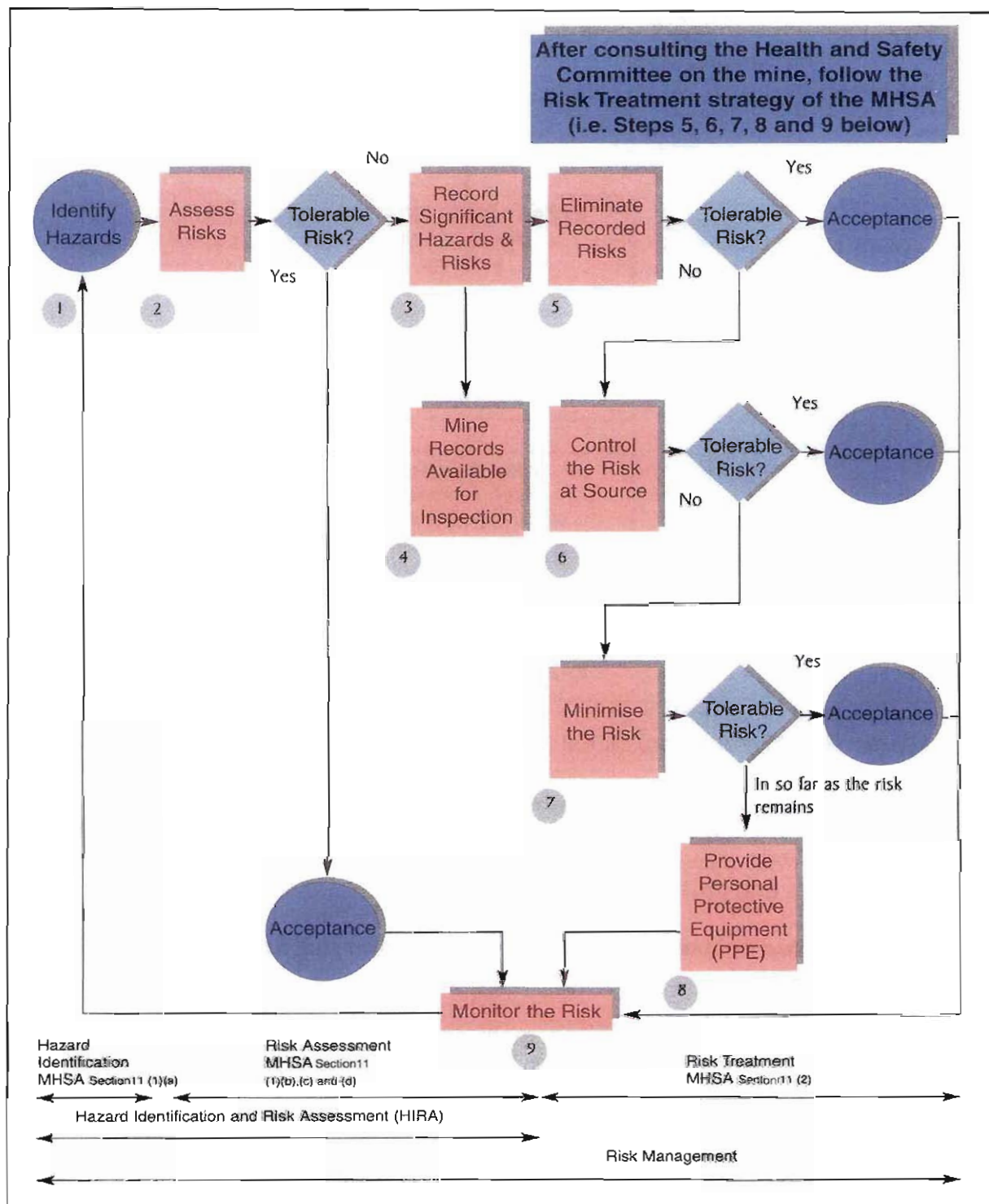


Figure 3.7. The Risk Management Process (CoMofSA, 2001).

Rampal & Sadhra (1999) proposed a model, shown in Figure 3.8, which attempts to look at the decision-making process that occurs at policy level, and which can also be used to perform risk assessment and to manage the risk identified and prioritized.

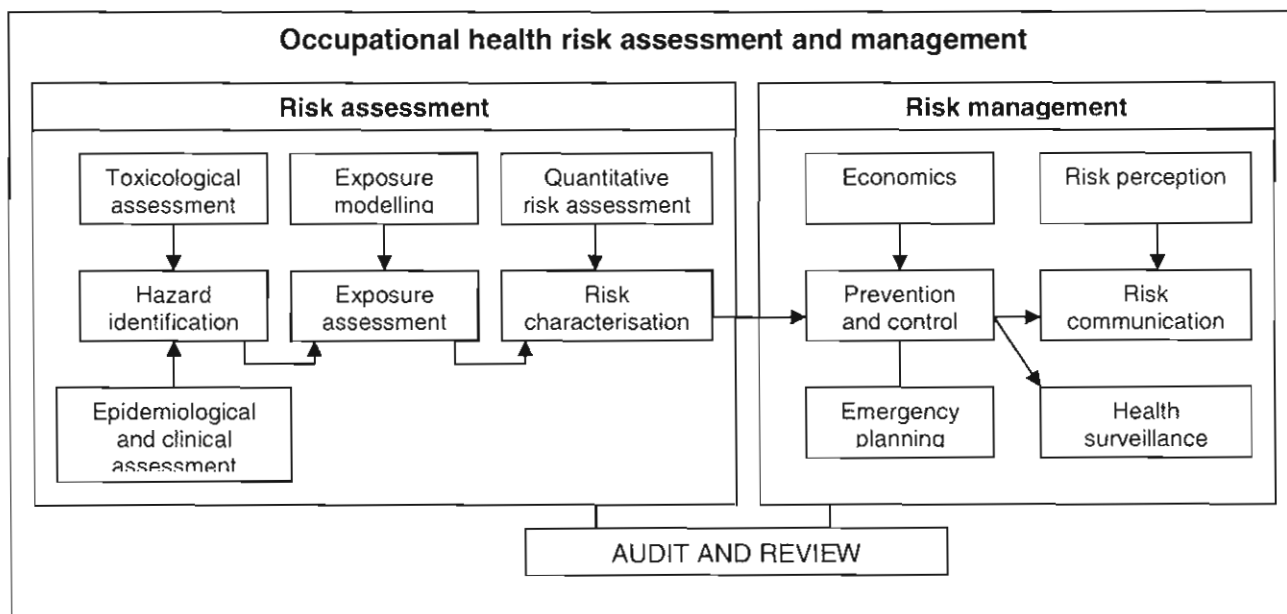


Figure 3.8. Model for risk assessment and management

3.6 Risk characterisation

Occupational health risk assessment is a structured approach that aids in the consistency of decision-making and the cost effectiveness of the allocation of resources. The four principle elements of occupational health risk assessment for human health are: hazard identification, dose-response assessment, exposure assessment and risk characterisation. Risk characterisation can be defined as the process for estimating the incidence and severity of the adverse health effect likely to occur due to actual or predicted exposure to a workplace hazard. Thus, risk characterisation is the product of the risk assessment process that can be used by employer to develop and prioritise control strategies and to communicate risks.

The obtained information from the first three elements of the occupational health risk assessment process, i.e. hazard identification, dose-response assessment and exposure assessment can be combined to determine the level of risk and its tolerability. Once a risk has been characterised, the employer has the responsibility to protect the potentially exposed population adequately.

3.6.1 Risk assessment matrices

Risk matrices are applied to determine “non-subjectively” risk priorities. Often, a risk matrix is used to help prioritize risks and risk reduction measures, giving consideration to incident probability and the severity of injury or illness that could result. A risk matrix

present risk in a manner that can be visualised. The elements to consider in applying a risk assessment matrix are:

- Likelihood of the occurrence of a hazardous event or exposure; and
- Severity of injury or illness that can result.

Countless probability, severity, and frequency of exposure exhibits and risk assessment matrices appear in literature. The meanings of the terms used have wide variations. The evaluation of risk and risk matrix used will depend on the method used to estimate the risk. Risk evaluation can be carried out qualitatively, semi-quantitatively or quantitative.

3.6.2 Qualitative risk evaluation

Judgement is used and a simple ranking mechanism of “low”, “moderate” or “high” is utilised. This is especially useful when performing the “baseline” type risk assessment where the object is simple to identify the “significant” risks that are then more comprehensively measured and/or analysed. It is difficult to prioritise interventions with this method.

Advantages:

- Simple and easy to use; and
- Useful to identify the ‘significant’ risks.

Disadvantages:

- Difficult to prioritise interventions with this method.

Table 3.1. Qualitative risk evaluation after British Standard 8800

	Slightly harmful	Harmful	Extremely harmful
Highly unlikely	Trivial risk	Tolerable risk	Moderate risk
Unlikely	Tolerable risk	Moderate risk	Substantial risk
Likely	Moderate risk	Substantial risk	Intolerable risk

(BS 8800:1996)

Table 3.2. Action for risk levels after British Standard 8800

Risk level	Action and timescale
Trivial	No action is required and no documentary records need to be kept
Tolerable	No additional controls are required. Consideration may be given to a more cost-effective solution or improvement that imposes no additional cost burden. Monitoring is required to ensure that the controls are maintained.
Moderate	Efforts should be made to reduce the risk, but the costs of prevention should be carefully measured and limited. Risk reduction measures should be implemented within a defined time. Where the moderate risk is associated with extremely harmful consequences, further assessment may be necessary to establish more precisely the likelihood of harm as a basis for determining the need for improved control measures.
Substantial	Work should not be started until the risk has been reduced. Considerable resources may have to be allocated to reduce the risk. Where the risk involves work in progress, urgent action should be taken.
Intolerable	Work should not be started or continued until the risk has been reduced. If it is not possible to reduce the risk even with unlimited resources, work activity has to remain prohibited.

(BS 8800:1996)

3.6.3 Semi-quantitative risk evaluation

This evaluation involves the use of a matrix based on the rating of hazards and the rating of likelihood of exposure, as shown in the models to follow. Risks can be rated as low, moderate or high. It provides a useful means of ranking risk on a comparative scale and is more practical than the quantitative methods.

Advantages:

- Useful means of risk ranking;
- Comparative scale; and
- More practical than quantitative methods.

Disadvantages:

- More complicated than the qualitative methods.

Table 3.3: Semi-qualitative risk evaluation

Risk Rating = change x frequency x effect	
CHANGE OF SITUATION INVOLVING IN INJURY OR DAMAGE	
Change	Score
Not likely	1
Conceivable, but unlikely	3
Conceivable	5
Quite possible	7
Very possible	10
FREQUENCY OF THE SITUATION OCCURRING	
Description	Score
Once a year	1
Few times a year	3
Once a month	5
Once a week	7
Once a day	9
Continuously	10
EFFECT EXPECTED FROM SITUATION	
Effect	Score
First aid, little damage: R 1000	1
Medical treatment, damage: R 5000	3
LTI, significant damage: R 100 000	4
LTI for months, damage: R 200 000	6
LTI perm, disability, damage: R 300 000	8
Death, disastrous damage: > R 500 000	10

(Schoeman, 1999).

Table 3.4: Risk rating and risk management

RATING	RISK	MANAGEMENT
0 – 27	Slight	Possibility accept
28 – 90	Possible	Attention required
91 – 200	Considerable	Correction required
201 – 440	High	Immediate correction
> 440	Very high	Stop plant / activity

(Schoeman, 1999).

Table 3.5. Semi-qualitative risk evaluation

Risk	Exposure rating	Health effect rating		
0	No contact with/exposure to health hazard	Reversible effects of little concern or no known or suspected adverse health effects		
1	Infrequent contact/exposure at low levels (<Action level)	Reversible health effects of concern		
2	Frequent contact/exposure at low levels (<Action level) or infrequent contact/exposure at high levels (>OEL)	Severe, reversible health effects of concern		
3	Frequent contact/exposure at high levels (>OEL)	Irreversible health effects of concern		
4	Frequent contact/exposure at very high levels (>1,5 OEL)	Life threatening or disabling injury or illness		

(Strydom, 2001).

		PROBABILITY				
		1	2	3	4	5
C O N S E Q U E N C E	4	11	7	4	2	1
	3	15	12	8	5	3
	2	18	16	13	9	6
	1	20	19	17	14	10

PROBABILITY CATEGORY	DEFINITION
5	Possibility of repeated incidents
4	Isolated incidents known to have occurred
3	Possibility of occurring sometime
2	Unlikely to occur
1	Practically impossible

CONSEQUENCE CATEGORY	DEFINITION
4	Serious long or short term effects that may be fatal
3	Serious adverse health effects that would require off-site medical treatment
2	Non life threatening health effects that may require on-site first aid treatment
1	Little if any adverse health effects

Figure 3.9. Semi-qualitative risk evaluation (Guild & Marais, 2001).

3.6.4 Quantitative risk evaluation

This evaluation involves the use of mathematical equations that is an extension of the low, medium and high scenarios and describes risk as a frequency of illness and death.

Advantages:

- Useful means of risk ranking;
- Comparative scale; and
- More practical than quantitative methods.

Disadvantages:

- May not be any more precise than the semi quantitative evaluation
- Could under/over estimate risk

a) Quantitative risk evaluation as defined by Guild and Marais.

Risk rating = Consequence rating x Likelihood rating

Risk rating = Consequence rating x Probability of exposure x Period of exposure

Figure 3.10. Quantitative risk rating (Guild & Marais, 2001).

Consequence is based on the severity of harm or damage that can occur and likelihood is based on the chance of exposure and the proportion of time exposed to the hazard. The likelihood rating is based on both level of exposure to a hazard and the longevity of exposure, thus:

Table 3.6: Quantitative risk evaluation

RISK FACTOR		VALUE
Probability of exceeding OEL	Continuously exceeding	10
	Intermittently	6
	Unusual, but possible	3
	Only remotely possible (has happened somewhere)	1
	Conceivable, but very unlikely (has not happened yet)	0,5
Period exposed	Continuous for 8 hour shift	10
	Continuous for between 2 and 4 hours per shift	6
	Continuous for between 1 and 2 hours per shift	3
	Short periods of time (a few times per month)	2
	Unusual (a few times per year)	1
	Rare (once per year)	0.5
Consequence	One or more fatalities	100
	Major disability	50
	Serious illness – absent for longer than 14 days	15
	Major illness – absent for longer than 7 days but less than 14 days	7
	Minor illness – absent for 7 days or less	1

(Guild & Marais, 2001)

Table 3.7. Criteria for tolerability of risk

CALCULATED RISK	RISK CLASSIFICATION	ACTION
400 and above	Intolerable risk	Consider discontinuation
200 – 399	Very high risk	Immediate action required
70 – 199	High risk	Correction required
20 – 69	Potential risk	Attention necessary
Under 20	Tolerable risk	Monitor

(Guild & Marais, 2001)

b) Quantitative risk evaluation as defined by Schoeman

The mathematical equation for the calculation of the occupational health risk rating, is shown in Figure 3.11.

$$\text{Risk} = \text{Consequence (C)} \times \text{Exposure (E)} \times \text{Probability (P)}$$

Figure 3.11. Calculation of the occupational health risk rating (Schoeman, 1998).

This model is based on the dose effect relationship. The associations between the above-mentioned parameters and the dose effect relationship are given by the following equation:

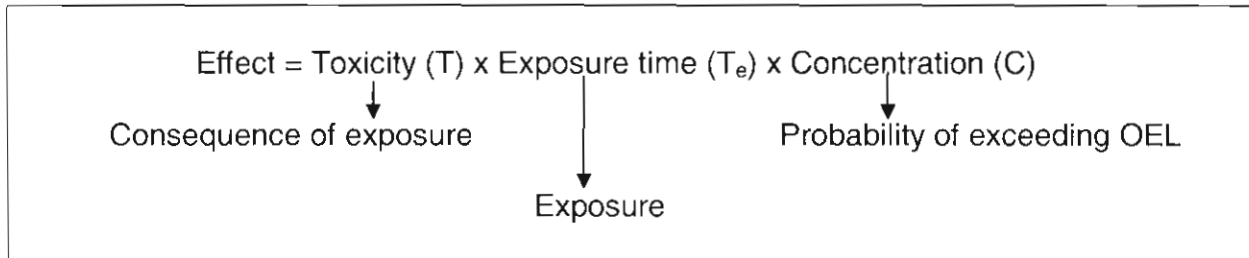


Figure 3.12. The dose effect relationship (Schoeman, 1998).

A numerical value is attached to each component, derived from Table 3.8. Following this step the health risk rating is calculated. Once the risk has been calculated, it is classified, as per Table 3.9.

Table 3.8. Risk factors

RISK FACTOR	VALUE
Probability of exceeding OEL	
Exceeding OEL-C or OEL more that four fold (Might well be expected, happens often)	10
Exceeding OEL-STEL or TWA more than three fold (Quite possible)	6
Exceeding OEL-TWA (Unusual, but possible)	3
Exceeding action limit (50% of OEL-TWA)(Only remotely possible has happened somewhere)	1
Exceeding 25%of the OEL-TWA (Conceivable, has not happened yet)	0,5
Exceeding 10% of the OEL-TWA (one in a million)	0,2
Virtually impossible (approaches the impossible)	0,1
Exposure	
Continuous for 8 hour shift (Continuous)	10
Continuous for between 2 and 4 hours (Frequent, daily)	6
Continuous for between 1 and 2 hours (Often, weekly)	3
Short periods of time, a few times per day (Unusual, monthly)	2
Very unusual, a few times per week (A few times per year)	1
Rare, a few times per month (Yearly)	0,5
Exceptionally exposed, a few times per year (Exceptional)	0,1
Consequences	
Catastrophic (many mortalities or damage over R 10 000 000,00)	100
Disaster (a few mortalities or damage over R 5 000 000,00)	40
Very serious (one mortality or damage over R 1 000 000,00)	15
Serious (many permanent illnesses or damage over R 500 000,00)	7
Serious (few permanent illnesses or damage over R 100 000,00)	6
Serious (one permanent illness or damage over R 20 000,00)	5
Important (many temporary illnesses or damage over R 10 000,00)	4
Important (few temporary illnesses or damage over R 5 000,00)	3
Important (one temporary illness or damage over R 2 000,00)	2
Of concern (many minor illnesses or damage over R 1 000,00)	1
Of concern (few minor illnesses or damage over R 500,00)	0,5
Of concern (one minor illness or damage over R 200,00)	0,1

(Schoeman, 1998)

Table 3.9. Risk classification

Risk calculation	Risk classification	Action
400 and above	Very high	Consider to discontinue
200 – 399	High risk	Immediate correction required
70 – 199	Risk	Correction needed
20 - 69	Possible risk	Indicate attention necessary
Under 20	Tolerable risk	Legislative requirements

(Schoeman, 1998)

c) Quantitative risk evaluation as defined by the Department of Minerals and Energy, South Africa

In the Occupational Hygiene Codebook published by the Department of Minerals and Energy (Department of Minerals and Energy, 2002), assessed risks (chemical risks and physical risks (i.e. noise and thermal stress) are to be classified based purely on the measured magnitude of the present health risk).

Advantages:

- Useful means of risk ranking;
- Comparative scale; and
- Risks are categorised based on sound measurements.

Disadvantages:

- Risks can only be categorised once measurements were taken;
- Time consuming;
- May not be any more precise than the semi quantitative evaluation; and
- Current, only applicable to chemical and physical (noise and thermal stress) health hazards. Could however be adopted for other stresses as well.

Chemical health hazards

Table 3.10. Classification of airborne pollutants (excluding toxic gases and vapours)

CATEGORY	CLASSIFICATION BANDS
	PERSONAL EXPOSURE LEVEL
A	Exposures $\geq$ the OEL or mixtures of exposures ≥ 1
B	Exposures $\geq 50\%$ of the OEL and $< \text{OEL}$ or mixtures of exposures $\geq 0,5$ and < 1
C	Exposures $\geq 10\%$ of the OEL and $< 50\%$ of the OEL or mixtures of exposures $\geq 0,1$ and $< 0,5$

(Department of Minerals and Energy, 2002)

Table 3.11. Classification of toxic gases and vapours

	CLASSIFICATION BANDS
CATEGORY	PERSONAL EXPOSURE LEVEL
A	Exposures $\geq$ the OEL or mixtures of exposures ≥ 1
B	Exposures $\geq 50\%$ of the OEL and the OEL or mixtures of exposures $\geq 0,5$ and 1

(Department of Minerals and Energy, 2002)

Physical health hazards

Table 3.12. Classification of noise

CATEGORY	PERSONAL EXPOSURE LEVEL	GENERAL ACTION
A	Exposures ≥ 105 dB $L_{Aeq, 8h}$	Implement formal Hearing Conservation Programme
B	Exposures $\geq 85 < 105$ dB $L_{Aeq, 8h}$	Implement formal Hearing Conservation Programme
C	Exposures ≥ 82 dB $L_{Aeq, 8h}$ and < 85 dB $L_{Aeq, 8h}$	No special precautions; monitoring required

(Department of Minerals and Energy, 2002)

Table 3.13. Classification of thermal stress – heat

CATEGORY	TEMPERATURE RANGE	INTERPRETATION	GENERAL ACTION
A (Abnormally hot)	WB > 32,5 °C or DB > 37,0 °C or Globe temperature > 37,0 °C	Unacceptable risk of heat disorders.	Work may be undertaken only on a basis of expert risk assessment, supervision and protocols. HSM mandatory.
B	29,0 > WB ≤ 32,5 °C and DB ≤ 37,0 °C Globe temperature: as for DB	Potentially conducive to heat disorders.	HSM mandatory.
C	27,5 > WB ≤ 29,0 °C and DB ≤ 37,0 °C Globe temperature: as for DB	Potentially conducive to heat disorders.	HSM mandatory.
D	WB ≤ 27,5 °C and DB ≤ 32,5 °C Globe temperature: as for DB	Risk of heat disorders negligible.	No special precautions Environmental monitoring must be sufficiently sensitive to detect critical upward drifts in the environmental heat load. The monitoring programme to satisfy this requirement should be specified.

(Department of Minerals and Energy, 2002)

Table 3.14. Classification of thermal stress – cold

CATEGORY	TEMPERATURE RANGE	INTERPRETATION	GENERAL ACTION
A (Abnormally cold)	≤ -30° C	Severe risk (frost bite)	Stop work; evacuate
B (Severe cold)	≤ 5° C but not ≤ -30° C	Potential risk	Implement formal CSM
C (Cold)	>5° C	Negligible risk	No special precautions; monitor equivalent chill temperature

(Department of Minerals and Energy, 2002)

3.7 Control strategies

Control of a hazard that has the potential to produce a risk to health can be achieved by:

- eliminating the agent; or

- reducing the exposure / dose produced by the agent to as low as reasonable practicable.

The options available to control emissions from a source are explained below and shown in Figure 3.13. There are six domains where interception of, or reaction to, a health hazard can occur:

Source

The source has the potential to release the health hazard/risk into the work environment. Questions that should be asked are: Can the source be eliminated or substituted with another less hazardous source? Can the total process be changed to improve performance and, simultaneously, reduce the risk? Can the source/material/chemical substance be replaced or substituted with a less hazardous source/material/chemical substance?

Emission

If the source is a chemical or biological material, can contamination from the source be controlled at the point of emission by means of total enclosure or by the use of local extraction ventilation?

Transmission path

Can the hazard be controlled along the transmission path, by a physical barrier, by extraction ventilation or supply ventilation, or by separating the source from the employees by means of larger distance?

Absorption

Can the significance of a potential exposure be reduced by absorption, which will minimise the passage of the hazard into the body? Personal protective equipment is an example of this control strategy.

Receiver

One aspect of control at the receiver is to set a minimum contact time in which an employee is exposed to the hazard. Another control aspect is the use of personal protective equipment

Effect

Effect control seeks to identify the presence of biological dysfunction/physiological effects. It is particularly useful for the mechanical, ergonomic, and psychological factors where no quantifiable exposure standards have been established. For such factors, the detection of dysfunction in its early stages is an important mechanism for the identification of excessive exposures and/or the presence of the intolerant individual.

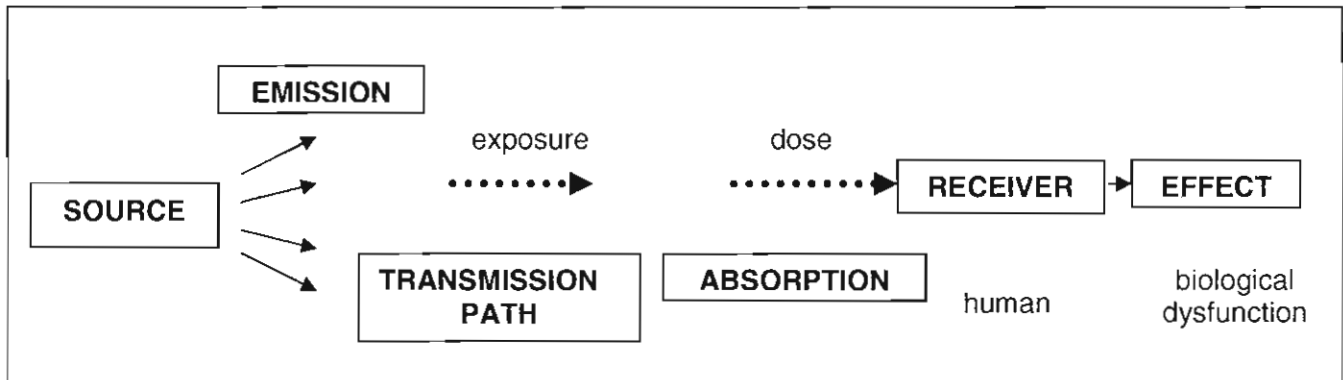


Figure 3.13. Emission control model (Australian National University, 2001).

3.7.1 Hierarchy of control

Control measures vary in their effectiveness in elimination or minimising exposure to health hazards. Those methods that are potentially the most effective are placed at the top of a preferred hierarchy of control options and used first, where practicable, in designing the hazard control system.

The preferred hierarchy of control is broadly segregated into elimination, engineering and administration controls, and personal protective equipment. Elimination is the most effective and permanent control. Engineering methods achieve control without the need for active participation by the workforce and, as such, are generally considered the more effective. Administrative control methods rely on active management leadership and workforce participation to be effective. The hierarchy of control can thus be illustrated as in Figure 3.14.

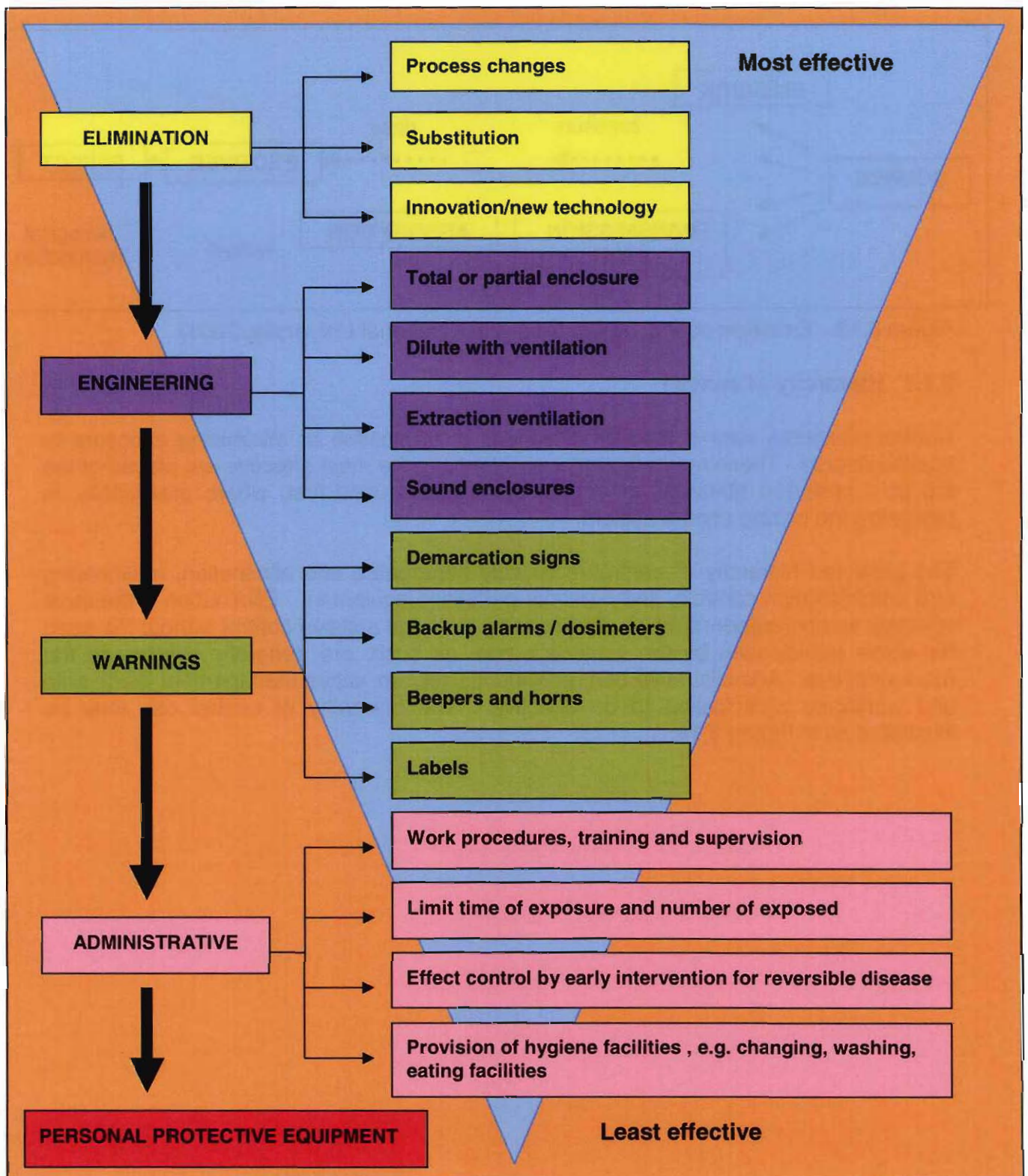


Figure 3.14. Hierarchy of controls

3.8 Recording of the occupational health risk assessment

A written record of each assessment must be kept. This means, writing down all the identified hazards identified and the significant risks assessed, evaluation criteria applied and conclusions. This information must also be communicated to the employees (Ferrie, 2001). Each risk assessment should be documented so that there is a reliable statement and evidence of what appropriate actions management is taking to protect the health of employees, i.e. to demonstrate that risks of an activity and the steps required to control them have been considered and to comply with legal requirements.

It is important that the recorder of the risk assessment reports those findings (risks) which are judged to be significant. These include:

- The major hazards identified in the assessment. That is, those hazards which, if they are not properly controlled pose serious risks to employees or others who may be affected;
- A review of the existing control measures and the extent to which they are effective in controlling the risks;
- Those who may be affected by the significant risks or major hazards including those groups and employees who are especially at risk (SIMRAC, 1997).

There is no rigid format or list of contents defined in the Mine Health and Safety Act (29/1996) and Regulations for the risk assessment report, but whatever the format, it should be easily accessible by employees, their representatives and inspectors.

More detailed requirements for the contents of a record of risk assessment is found in Regulation 9, the Hazardous Chemical Substances Regulations, of the Occupational Health and Safety Act (85/1993). Regulation 9(5) requires the following to be taken into account when making an assessment and generating a record of the assessment:

- the hazardous chemical substance (HCS) to which an employee may be exposed;
- what effects the HCS can have on an employee;
- where the HCS may be present and in what physical form it is likely to be;
- the route of intake by which and the extent to which an employee can be exposed;
- the nature of the work, process and any reasonable deterioration in, or failure of, any control measures

Although the above requirements focus on hazardous chemical substances, it could be adapted for other stressors.

3.9 Occupational health risk communication

Communication of risks is a crucial component of any effective risk management process. Risk communication is the process of conveying risk information to the stakeholders and interested and affected parties. Effective communication addresses

social concerns as well as scientific results, and is dependant upon the specific audience of interest. It is important to note that how people respond to risk will depend in part on how they perceive the risk – how hazardous they think it may be and how likely they are to be exposed (Smith, 1999).

Employees usually respond to risk, and to risk controversies, similar the way everyone else does.

There are nonetheless some differences worth noting as indicated by Sandman, (2003):

- **Employees are likelier to shrug off risks**

Employees tend to take the same risk less seriously than outsiders do – despite the fact that their actual risk is higher.

Two main reasons for this. First, employees are much more familiar than outsiders with the risk, and familiarity breed contempt. Second, our society sees on-the-job risk as more tolerable than bystander risk. Regulatory standards are tougher for environmental exposures than for workplace exposures; media coverage is greater for off-site releases than for those confined to the site. Perhaps surprisingly, employees generally agree with this assessment. They figure being exposed to a certain amount of risk is part of the job.

A third reason is, employees tend to shrug off risks: They've got health professionals worrying for them. When employees under-react to a risk, we tend to assume they're not worried enough about that risk. It's just as likely that they're irritated at the precautions and the people who are pushing the precautions. (Sandman, 2003).

An important fourth reason, in the South African culture/context, is the high unemployment rate. Employees would take risks to earn an income.

- **Employees are likelier to hide their outrage until it is huge**

When outsiders are outraged about a risk emanating from a facility/operation, they usually say so. Employees, on the other hand, may keep their outrage to themselves. Employees fear job repercussions if they complain about job risks. Even in a company that tries hard to protect whistle-blowers (and just plain complainers), it's still the gung-ho worker who gets promoted, not the skittish one. In many companies, employees are right to believe that expressing concern about a workplace hazard increases their chances of getting downsized. (Sandman, 2003).

But that's probably not the biggest reason why employees hide their outrage. Displeasing "management" is a fairly distant threat compared to displeasing one's immediate supervisor, who controls a variety of perks and punishments that make the job more or less bearable. Still more potent, typically, is the fear of displeasing

one's peers. On a work team where camaraderie is important, teasing is rampant and fearlessness is the norm, a worker who worries out loud about job risks faces ridicule or worse.

- **Employee outrage has more sources and can do more harm**

Employees have other relationships with the company besides the risks they endure. These relationships not only give employees a motive to hide their outrage; they also give employees additional sources of outrage. Employees who hate their jobs or are afraid of losing their jobs (or both) are likelier to think the solvents are giving them headaches. Low morale leads to risk controversies. And risk controversies damage morale – not to mention their effect on turnover, absenteeism and productivity. All these factors deteriorate when employees are upset about a risk, even if they keep their feelings quiet. Outraged employees are also likelier to file a lawsuit or a workermans compensation claim and likelier to go on strike. When outsiders are outraged about a risk, they can raise a ruckus, hurt the company's reputation and maybe inspire new regulations. Outraged employees can do all that and more.

Outraged employees are likelier to have actual work-related accidents and illnesses, too. This key connection between outrage and hazard shouldn't be neglected. At its most extreme, employee outrage can lead to sabotage – and a huge hazard to employees, neighbours, environment and management alike.

- **Employees are easier to communicate with**

From Material Safety Data Sheets (MSDSs), to periodic health and safety meetings, to union-management health and safety committees, the employer have a wide range of options for reaching employees with risk information. Employees may not want to listen; they may not believe what they hear. But at least the employer has access. Reaching outsiders is a lot tougher.

On the other hand, employee communication may be constrained by a variety of legal and contractual obligations that specify what must and must not be said.

The Mine Health and Safety Acts' Regulations and union rules are supposed to facilitate honest communication, but sometimes they prevent it instead. A special danger is imagining that formal communication with the union replaces talking to employees. It doesn't. The union doesn't stand in for the workforce any more than the government stand for the community.

- **Employees are a part of community outreach for better or for worse**

In an external risk controversy, employees are a key information source for their neighbours. If they share their neighbours concern, the concern is confirmed. If they don't know the first thing about the issue, that's just as harmful. If they have

been properly briefed with accurate information, not a one-sided gloss they can be invaluable.

What is said (or not said) to employees will get out to the neighbourhood, what is said to/in the neighbourhood gets back to employees. If the company seems more attentive to outsiders complaints than it is to employee's complaints that can generate employee outrage. If the company apologizes to outsiders in a way that seems to blame the workforce, that can generate employee outrage. If the company assumes that employees are on management's side in a controversy with outsiders, that can generate employee outrage. If the company assumes that employees are uninvolved and irrelevant, that can generate employee outrage. Every external risk communication should be scrutinised for its likely impact on employees.

3.9.1 Employees' right to information

As per Section 19 of the Mine Health and Safety Act (29/1996), an employee may request, and the employer must then provide, a copy of the record or of any part of it that is being kept in terms of Section 12(3) and Section 13(3)(c) of the Act and that relates to that employee. This includes occupational health risk assessment records.

Section 11 of the Act, specifies the following as minimum contents for risk communication:

- the risks associated with any work that employees have to perform;
- the risks that have been identified by risk assessments;
- the measures necessary to eliminate, minimise or control those risks to health (or safety);
- the procedures to be followed to perform work safe and without risk to health; and
- emergency procedures.

Objectives of risk communication

The objective of occupational health risk communication should be:

- to ensure legal compliance in terms of risk communication;
- to engage in dialogue with employees;
- to design and implement a collaborative problem solving process;
- to assist with the communication of information to employees, and
- to build trust and credibility between employees and employer.

Benefits of risk communication

Benefits that could be expected from occupational health risk communication include:

- early identification and consideration of all issues and concerns;
- opportunity for the employees to buy into decision making process;
- establishment of a common language between employees from different backgrounds;
- strengthened relationships and credibility among all parties;
- improve understanding workplace risks and of comparative workplace risks;
- reduced possibility of costly litigation and employee conflict;

- improve employer image, creating a more inviting climate sustainable development and investment;
- recognition of both qualitative and quantitative occupational health hazards and risks; and
- consideration of environmental, economic and social impacts.

Risk communication guidelines

When engaging into occupational health risk communication with employees and / or their representatives, the following guidelines should be considered:

- describe what individuals can do to reduce their exposure;
- describe what management and the government do to reduce risk;
- describe both benefits and risks to specific audience;
- describe alternatives and their risks;
- describe how people can get involve in decision making; and
- provide information that will help the audience (employees) to evaluate their risk

3.9.2 Seven cardinal rules of risk communication

When communicating the results and findings of an occupational health risk assessment to employees, the following seven cardinal rules of risk communication should be kept in mind:

- accept and involve employees as legitimate partners;
- plan carefully and evaluate efforts;
- listen to the employees' specific concerns;
- be honest, frank and open;
- co-ordinate and collaborate with other credible sources;
- meet the needs of the employees and employee representatives; and
- speak clearly and with compassion.

3.10 Occupational health risk assessment review

Almost all processes and activities are dynamic in nature, and evolve with development. Under these circumstances, it is probable that the assessment will eventually become invalid. Even where processes and activities are static, it would be wise to review the assessment periodically (e.g. every two years), unless continuous occupational health risk assessments are conducted, to establish if working practices have changed with staff turnover, and to see if any new information about hazards or control measures has come to light.

It must be ensured that a system is in place to recognise when assessments need to be repeated, and to bring forward assessments for review. Indicators to an assessment having become erroneous include:

- new advice provided by supplier;
- new information published which changes understanding of the risk due to a process, article or substance;
- complaints from employees;

- results from exposure monitoring rising or exceeding acceptable levels;
- health surveillance indicate that employees are suffering ill health effects;
- changes in work procedures, processes, plant, equipment, articles, substances or any other factor relevant to the work;
- changes in the rate of production;
- alterations to the shift pattern of duration; and
- if there is reason to suspect that the previous assessment is no longer valid.

It is not necessary to amend an assessment for every trivial change, or even for each new job, but if a new job introduces significant new hazards of its own, it must be considered in its own right.

3.11 Deliverables of the Occupational Health Risk Assessment

The occupational health risk assessment should be used as the cornerstone for the development of all other occupational health systems and programmes. Even the occupational health policy and procedures should flow from the risk assessment. It is critical for occupational health professionals to have a comprehensive approach to occupational health issues. Occupational health professionals must stay away from fire fighting and rather have a holistic approach to occupational health. The relationship between an occupational health risk assessment and other relevant issues are depicted in the following figure:

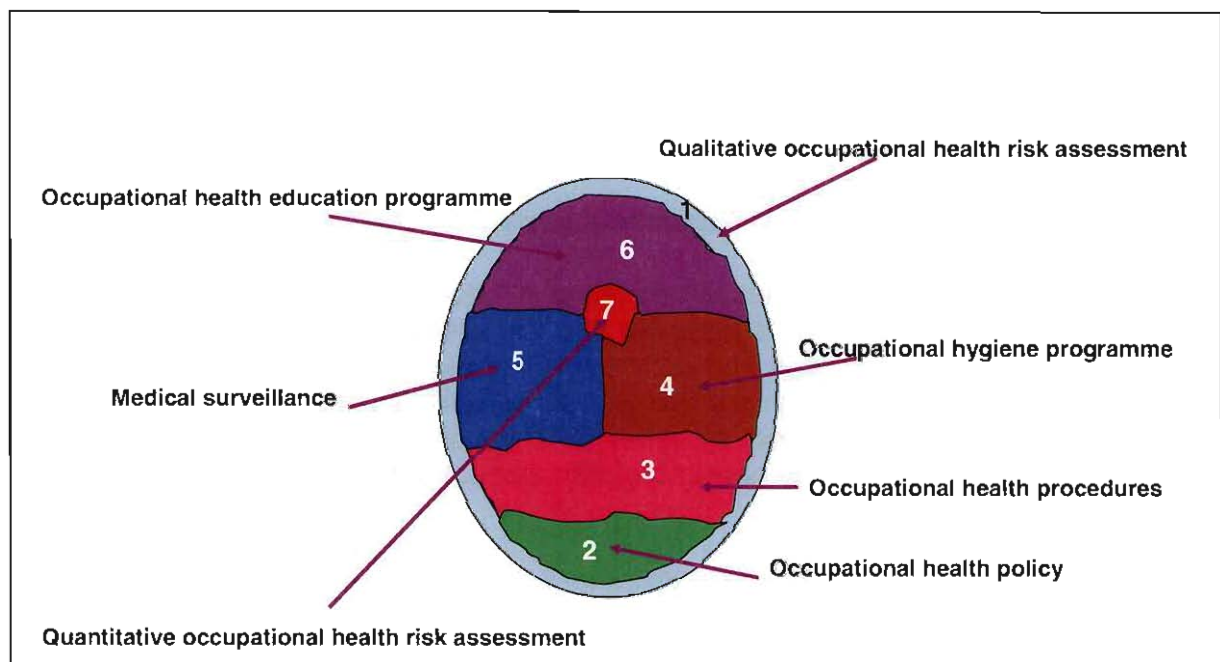


Figure 3.15. Relationship between OHRA and other relevant programmes (Schoeman, 2001).

In reality, the process should flow as follows:

- i) Conduct an occupational health risk assessment;
- ii) Identify the significant hazards and risks to health;
- iii) With data obtained from the above processes, compile an occupational health policy;
- iv) Compile occupational health procedures;
- v) Design and implement an Occupational Hygiene programme;
- vi) Design and implement an Occupational Medicine programme;
- vii) Design and implement an occupational health educational programme.

Once these programmes are in place, quality systems should be designed to maintain these programmes and also to ensure continuous improvement as required by recognised occupational health management systems such as OHSAS 18001 (Schoeman, 2001).

Deliverables from an occupational health risk assessment thus are:

- Occupational health policy
- Occupational health procedures
- Exposure monitoring strategy/programme
- Guidelines for medical surveillance
- Guidelines for education and training
- Occupational health risk profiles
- Guidelines for functional work capacity

These deliverables are discussed in detail below.

3.11.1 Occupational health policy

An occupational health policy establishes an overall sense of direction and sets the principles of action for an organisation. It sets occupational health objectives for occupational health responsibility and performance required throughout the organisation. It demonstrates the formal commitment for an organisation, particularly that of the organisation's top management, towards good occupational health management.

The organisation's top management should draft and authorise an occupational health policy taking into account the points below. An effectively formulated occupational health policy should:

- be appropriate to the nature and scale of the organisation's occupational health risks (*hazard identification, risk assessment and risk control are at the centre of a successful occupational health management system and should be reflected in an organisation's occupational health policy. The policy should be consistent with a vision of the organisation's future. It should be realistic and should neither overstate the nature of the risks the organisation faces, nor trivialise them*);
- include a commitment to continual improvement;
- include a commitment to at least conform to current applicable occupational health legislation and with other requirements to which an organisation subscribes;

- be documented, implemented and maintained;
- be communicated to all employees with the intent that all employees are made aware of their individual occupational health obligations;
- be available to interested parties; and
- be reviewed periodically to ensure that it remains relevant and appropriate to the organisation (Guild, 2001).

3.11.2 Occupational Health procedures

A procedure can be defined as a specified way to carry out an activity or a process. (ISO14001:2004, adapted from ISO 9000:2000). Occupational health procedures will therefore be the specified ways in which occupational hygiene and occupational medicine activities or processes are carried out. These procedures should be appropriate to the nature and scale of the significant health risks that were identified through the occupational health risk assessment process.

3.11.3 Occupational hygiene exposure monitoring strategy

When analyzing the occupational health risk assessment process it becomes obvious that a monitoring strategy must exist and if not, needs to be developed. Reasons for developing a monitoring strategy are:

- to use it in the occupational health risk assessment;
- to check compliance with Occupational Exposure Limits (OELs);
- to design exposure control levels;
- to evaluate the effectiveness of control measures;
- to inform employees of the pattern of exposure and level of risk;
- to indicate the need for medical surveillance;
- to keep records of environmental/workplace levels for statutory purposes,
- to establish in-house exposure standards, where necessary; and
- qualification of the levels of occupational health stressors.

There are basically two types of exposure monitoring:

- personal monitoring, which is used to establish the concentration of an airborne substance within the breathing zone of the employee; and
- area monitoring, which is used to establish the concentration of an airborne pollutant in the ambient atmosphere of a workplace and is useful to check the effectiveness of used control measures, to identify emission sources and to determine background workplace environmental contaminant concentrations.

a) Risk assessment and monitoring flow diagramme

Figure 3.16 shows a basic flow diagramme of the occupational health risk assessment process and the monitoring associated with it. Monitoring forms an important part of the risk assessment process and must not be neglected.

The OHRA process is often confused with exposure monitoring. Whilst some measurement and grab samples may be taken during an OHRA to establish the presence of, for instance, an airborne substance or excessive noise levels, such monitoring is not intended for the purpose of a statutory monitoring programme.

Results obtained in OHRAs should be regarded as baselines which will assist the assessor to compile an occupational hygiene monitoring programme and with qualification of levels of occupational health stressors.

b) Monitoring Strategies

When certain work activities or environments are to be monitored, there are basically three strategies that can be applied, namely:

- A basic monitoring survey which should be conducted when:
 - the initial baseline assessment suggests there is an exposure risk, but the extent of the risk is unknown;
 - major changes have been made to a process, procedures or control measures since the last assessment;
 - unusual or periodic operations are planned;
 - a new process is being commissioned; or
 - a new OEL has been set.
- A detailed monitoring survey which should be conducted when:
 - the extent and pattern of exposure can not be confidently assessed by a basic survey;
 - exposure is highly variable between employees doing similar tasks;
 - carcinogenic substances, skin absorbents or respiratory sensitisers are involved;
 - When the initial appraisal and basic survey suggest that the time weighted personal exposure may be very close to the OEL limits;
 - the cost of additional control measures cannot be justified without evidence of the extent of the exposure variability; and
 - major maintenance and on-off jobs such as plant decommissioning is done.
- Routine / statutory monitoring

The Mine Environmental Engineering and Occupational Hygiene Regulations of the Mine Health and Safety Act (29/1996) requires routine monitoring based on risk, the greater the risk the more effort needed to control exposures.

A system of occupational hygiene measurements must be implemented in all working places where the following hazard levels prevail:

- Airborne pollutants:
 - particulates ≥ 0.1 OEL
 - gases / vapours ≥ 0.5 OEL
- Thermal stresses:
 - heat > 25.0 WB and / or $> 32^{\circ}\text{C}$ DB and / or $> 32^{\circ}\text{C}$ radiant heat;
 - cold $< 10^{\circ}\text{C}$ equivalent chill temperature;
- Noise:
 - ≥ 82.5 dB(A)

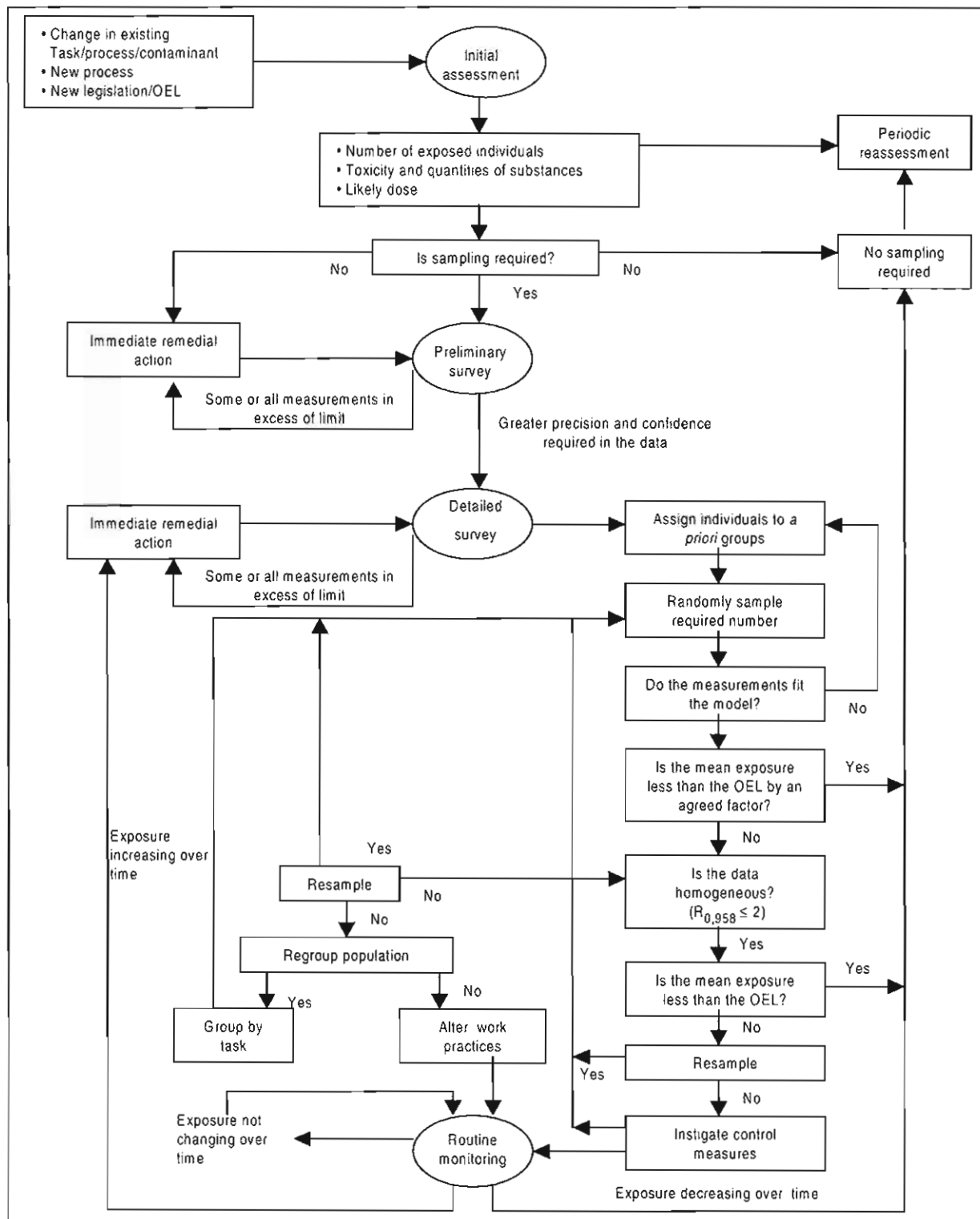


Figure 3.16. Risk assessment and monitoring flow diagramme (Harrington & Gardiner, 1995).

c) Sampling Methodology

When sampling of contaminants is to be done, it must be noted that the sampling methodology will be dependant on various factors. The sampling methodology to be used, for one, is dependant on the type of pollutant to be monitored, and the monitoring procedure decided upon, must be in accordance with internationally compatible best practice methodologies, for example NIOSH analytical methods. Where the available historical data is insufficient to enable professional judgment regarding the extent of any risk, acceptable methodologies such as stipulated by NIOSH-OESSM should be used to determine homogeneous exposure groups (HEGs) (Guild & Marais, 2001; SAIOH, 2001).

d) Analysis Methodology

When samples of contaminants have been taken it is very important for the employer to ensure that the analysis of the samples is only done by an accredited laboratory for specific analytical procedures required. The credibility of the results is therefore dependent on where the analysis was done.

e) Homogeneous exposure groups (HEGs)

HEGs are a group of employees who experience pollutant exposures similar enough that monitoring of exposures of any representative sub group of employees in the group is representative of the exposures of the remainder of the employees in the group.

f) Monitoring period and duration

If the process is continuous and has minimal variation, the choice of monitoring period is not of great importance. However, if the process is cyclic, it is critical that the monitoring is carried out at the time the employees are exposed. The choice of monitoring period is also closely linked to the type of health effect associated with the substance. The duration of the monitoring has to be sufficient to give results, which are representative of the whole range of exposures, including peak exposures and allow the relevant TWA exposure to be calculated. If there is considerable variation in the work pattern one may need to monitor on a number of days to cover anticipated variations.

3.11.4 Guidelines for risk based medical surveillance

Surveillance refers to the "vigilant supervision of individuals". Health surveillance refers to procedures for the supervision of health status and, in an occupational health contents, has been defined as "the periodic medicophysiological examination of exposed workers with the objective of protecting and preventing occupationally related diseases". The examinations include clinical and / or physiological assessments of specific occupational groups to detect the early effects of exposure to occupational hazards. The term "medical surveillance" refers to such procedures performed by, or under the supervision of, a physician (Aw, 1999).

In terms of Section 13 of the MHSA, the employer must establish and maintain a system of medical surveillance of employees exposed to health hazards:

- i) if required to do so by regulation or a notice in the Government Gazette; or
- ii) if it is necessary to do so after assessing the risks.

Any system of medical surveillance must be appropriate considering the health hazards to which employees are or may be exposed. Medical surveillance programmes should always be run as an adjunct to the occupational health risk assessment process and are an integral part of health risk management. The existence of sentinel cases of work-related diseases associated with specific chemicals may also inform the process. A practical approach in developing a risk based medical surveillance programme is outlined in Table 3.15.

Table 3.15: A stepwise approach for developing a risk based medical surveillance programme

Step 1	What is the result of the occupational health risk assessment process? If significant health risks exist, proceed with the prioritisation of the risks based on information from the risk assessment on the level of risk.
Step 2	What are the target organ health effects associated with excessive exposure to the particular health risk?
Step 3	Identify the appropriate tests which have a high degree of validity to make the assessment e.g. questionnaire, full blood count, serum urea, creatinine, etc. The availability of a valid test must be regarded as a prerequisite of the importance of the risk.
Step 4	Ensure that the requirements for conducting and analysing tests in a reliable manner are fulfilled: - machine specifications - calibration of equipment - qualifications of persons conducting the tests - accreditation of laboratory for analysis
Step 5	Standardise methodology for conducting tests at appropriate time intervals.
Step 6	Decide beforehand what action criteria will be used to define an abnormal test.
Step 7	Outline the process of referral to confirm diagnosis, remove the person from exposure, initiate treatment where appropriate and submit a workers' compensation claim should there be abnormal results or disease.
Step 8	Outline the procedures for notification of employer, employee and enforcement agency (DME, etc.).
Step 9	Arrange for post-employment examinations and exit certificate on termination of employment at a particular mine. Store historical medical surveillance records at facility for at least 40 years.
Step 10	Ensure evaluation and audit of the programme on a regular basis. Use information obtained through medical surveillance to assess the effectiveness of existing control measures.

(Stanton & Jeebhay, 2001.)

3.11.5 Guidelines for education, training and awareness

A suitable and sufficient occupational health training and awareness programme should be risk based. In terms of Regulation 3, Asbestos Regulations, Regulation 9, Hazardous Chemical Substances Regulations and Regulation 11, Lead Regulations of the Occupational Health and Safety Act (85/1996) an employee who is exposed or may be exposed to health hazards and risks in a workplace, must be comprehensively informed and trained with regard to:

- the contents and scope of laws and regulations pertaining to the hazards and risks;
- the potential sources of exposure;
- the potential risks to health caused by exposure;
- the potential detrimental effect of exposure on his or her reproductive ability;
- the measures to be taken by the employer to protect an employee against any risk of exposure;
- the precautions to be taken by an employee to protect himself or herself against the health risks associated with that exposures, including the wearing and use of personal protective equipment;
- the necessity, correct use, maintenance and potential of safety equipment, facilities and engineering control measures provided;
- the necessity of personal exposure sampling and medical surveillance;
- the importance of good housekeeping at the workplace and personal hygiene;
- the safe working procedures regarding the use, handling, storage and labelling of chemical substances in the workplace; and
- procedures to be followed in the event of spillage, leakages or any similar emergency situation which could take place by accident.

The importance of occupational health training and awareness programmes cannot be emphasized enough. Although these programmes are required by law, no employee can be expected to partake and assist implementing and maintaining a risk control programme if the employee does not know why control is necessary.

Employees should be provided with information, instruction or training that will be necessary for them to enable them to perform their work in a manner that is without risk to their, or anyone else's health. Employees should be made conversant with work-related health hazards and risks and the measures taken to eliminate, control or minimize these hazards and risks.

Employees must be properly trained to deal with all the hazards and risks to their health which is associated with any work that the employee has to perform and which has been identified through occupational health risk assessment. Further employees must be trained in the measures necessary to eliminate, minimise or control those hazards and risks to health, the procedures to follow to perform their work and in emergency procedures.

3.11.6 Occupational health risk profile

The occupational health risk profile is compiled from information gained from the occupational health risk assessments done of all workplaces, activities, tasks and departments on site.

A thorough and complete occupational health risk assessment and profile will allow for the early identification of impacts on the health status of the employees due to task related exposures in the work place, thus prompting early control strategies. The occupational health risk profile will further give direction and enhance the occupational health programme in place on site. The programme can be streamlined according to the profile, thus saving time and money as no blanket medical surveillance will need to be done.

Medical surveillance will be done according to identified risks. The profile will thus allow for effective planning and time allocation as well as effective budgeting for the occupational medical services required. Should there be no occupational health programme in place at the Operation, this profile will form the basis for the development of such a programme. An added benefit is that the profile will contribute positively to the management of occupational health risks at the Operation. Figure 3.17 shows an example of an occupational health risk profile.

The profile will support the availability of updated information on occupational health risks at the Operation. This makes the monthly communication to management on the health status of the employees easier and more effective. Training needs, for example the communication of health related risks during induction training as well as specific health education are indicated through the risk profile.

All in all, the profile ensures a risk based, quality occupational health service through ensuring risk management and minimum impact on the health status of the employees, whilst contributing positively to the bottom line of the Operation.

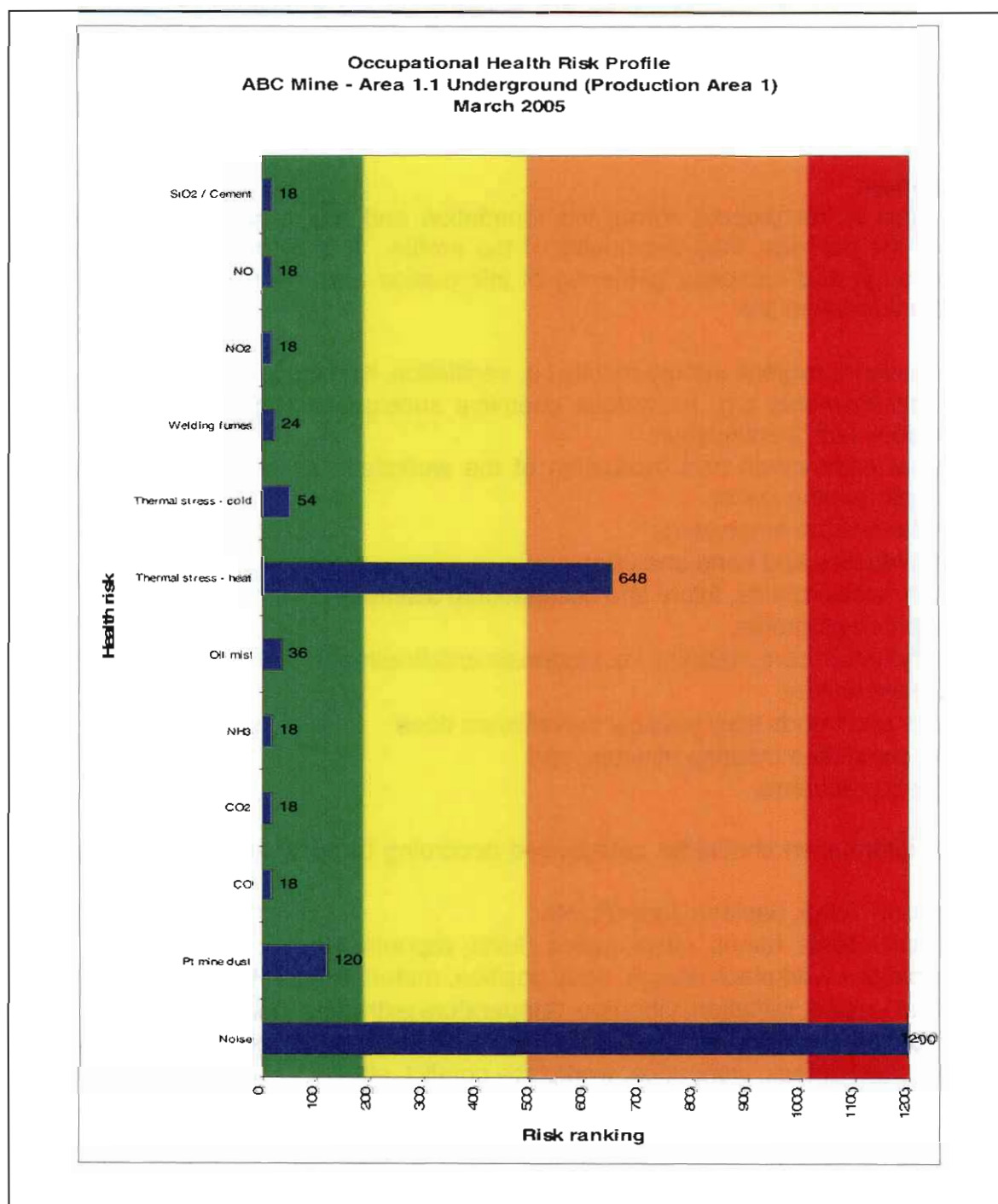


Figure 3.17. Example of an occupational health risk profile

a) Involvement in compiling profile

The occupational hygienist and the occupational medical practitioner will be the prime role players in this process, but the occupational health risk profile will be compiled as part of the occupational health risk assessments by the Risk Assessment Team

b) Process of compiling an occupational health risk profile

The process followed to compile the profile is in short the following:

i) Assessment

This first step in the process forms the foundation and has a direct impact on the outcome of the process, thus the quality of the profile. It is of utmost importance to ensure thorough and complete gathering of information and identification of hazards. Sources of information are:

- Occupational hygiene survey results i.e. ventilation, illumination, noise;
- Risk assessments e.g. hazardous chemical substances (MSDS's), ergonomics, hazardous task identification;
- Physical observation and evaluation of the workplace as well as of employees whilst performing tasks;
- Complaints from employees;
- Injury statistics and trend analysis;
- Compensation claims, injury and occupational disease;
- Workforce age profile;
- Primary health care statistics i.e. diagnosis and treatment;
- Sick leave history;
- Results and trends from medical surveillance done;
- Safety committee meeting minutes; and
- Suggestion scheme.

The above information should be categorised according to occupational health hazard type i.e.:

- Biological - fungi, bacteria, insects, etc.;
- Chemical - dusts, fumes, mists, gases, fluids, vapours, etc.;
- Ergonomics - workplace design, body position, materials handling, etc.;
- Physical - noise, radiation, vibration, temperature extremes, heights, etc.; and
- Psychological - work-rest cycle, fatigue, monotony, work pressure, shift work, danger level of task, work pace, workplace conflict, etc.

These stressors should be listed per workplace. The injury profile as well as the size of the workforce is indicated per area, as this detail is necessary for further statistical analysis.

ii) Risk identification, quantification and profile

Risks are identified in line with hazards identified per workplace. Risks are quantified on the basis of frequency of exposure, probability of the occurrence of ill health effects

when exposed as well as severity of damage to health, and a rating is given. According to ratings, risks are classed as high, medium or low risks. According to this classification, the risk profile is compiled.

iii) Risk management

The risk management strategy is developed according to the risk profile. Resources are thus applied as per the profile, from high to low risks. Risk management strategies will include limiting or reducing/preventing the effect of risk through engineering changes, change or cessation of process, use of alternative chemical substance in process, outsourcing process, use of personal protective equipment, medical surveillance, training and awareness.

iv) Profile updating

The occupational health risk profile should be re-evaluated and updated frequently to ensure effective management of health risks. The profile should be updated at a frequency of at least once a year. Further updates should be done when changes in the production process take place e.g. a different chemical is used, heat is added to the process, new machinery is introduced, when occupational hygiene measurement data indicates a change in the original profile, etc. The profile should also be updated should medical surveillance indicates an unexpected change of the health status of employees. Medical surveillance results will give an indication as to the success of the risk management programme.

c) Benefits

Benefits to be gained from the implementation of an occupational health programme based on the occupational health risk profile of an Operation include:

- a medical surveillance programme that is risk based and driven;
- resources for medical surveillance programme that is correctly determined and allocated;
- no blanket medicals are done as the extent of risk as well as the exposed group is known;
- effective utilization of resources (time, personnel, finance);
- development of an induction programme that is focussed on risks present in the workplaces;
- provision of information for future planning of provident fund, pension fund, medical aid scheme and possible future compensation claims due to loss of health status;
- assistance in the accurate determination of workforce health status;
- assistance in the statistical analysis and identification of trends;
- assistance in the determination of the extend of exposure;
- assistance in the development of person-job specifications with specific referral to medical exclusions;
- the effective prevention of incidents caused by ill health (medically unfit for position) or continuation in position where employee is medically unfit for the position;

- assistance in the development of standards and procedures as part of occupational health programme;
- contributes to completeness of Safety, Health and Environmental risk identification and profile of an Operation; and
- assist in the measurement of risk management programme effectiveness.

d) Requirements of implementation

The implementation of an occupational health programme that is based on an occupational health risk profile of an Operation demands effective communication and co-operation between the management team, the training department, the human resources department and the SHE department. It further requires a frequent update of the risk profile and dedicated and effective management of the programme.

A complete and up to date occupational health risk profile based on a comprehensive risk assessment forms the backbone of a successful occupational health programme. The result of this will be, over and above ensuring legal compliance, the effective maintenance of the health status of each individual at an Operation (Louw, 2004).

3.11.7 Guidelines for functional work capacity and fitness to perform work

The concept “fitness to work” implies that an occupation has inherent health requirements that need to be met by a person in that occupation in order to minimise the risk of injury or illness. The concept of fitness is thus closely associated with the concept of risk.

Occupational health risks fall into two categories:

- risks associated with exposure to hazard in a particular occupation. These hazards include noise, heat, dust, etc., with their associated adverse health effects on exposed employees; and
- risks associated with failure to meet the capabilities (physical or psychological) required of a particular occupation. Certain occupations pose particular demands on the employee’s ability to perform the work in a manner that does not increase the likelihood of injury or illness to the employee or to co-workers.

These two categories of risk imply four occupational categories:

- those with specific health requirements, but low hazard exposure: e.g. bulk truck drivers, onsetters, banksmen;
- those with specific health requirements and high hazard exposure: e.g. rock drill operators, loco drivers;
- those with low health requirements, but high hazard exposure: e.g. welding, underground maintenance staff; and
- those with low health requirements and low hazard exposure: e.g. general surface workers, office and administrative staff.

Medical evaluation of fitness to work has to cover both types of risk. A programme of examinations should ensure that minimum medical requirements are met by employees,

and also that any adverse health effects from exposure to hazards in the workplace are detected at an early stage, enabling remedial action to be taken (Kew & Ehrlich, 2001).

Minimum standards of fitness

The minimum standards of fitness for an occupation are the capabilities that are required to perform the tasks required in the occupation (inclusive requirements), as well as those abnormalities that the employee should not have in order for the job to be performed safely.

Whilst it is not just morally obligatory but also legally on the employer must reduce or minimise the hazards to which employees are exposed, in certain circumstances inherent health and safety risks will remain.

The rationale for conducting such examinations is to ensure that people who have a reasonable likelihood of suffering from the hazards of the job or of imposing additional risk on co-workers are identified and managed in such a manner that the risks are minimized.

Occupational health risk assessment and minimum standards for fitness

Establishing minimum standards for fitness for work comprises of three steps:

- Occupational health risk assessment;
- Person-job specifications; and
- Setting standards for medical surveillance.

Step1 – Occupational health risk assessment

The objective of occupational health risk assessment is to identify all relevant health hazards and the degree to which the various occupations are exposed to these hazards. Risk is the product of both the hazard (the capacity to cause harm) and the extent of exposure. A clear understanding of these risks is essential prior to setting medical standards for these occupations. At the end of this occupational health risk assessment process, each occupation should have a clearly defined occupational health risk profile.

Step 2 – Person-job specifications *(also referred to as Man-job specifications)*

This step includes the process of documenting the risks for each and every occupation on the mine. These documents usually comprise a page per occupation, and are kept in a file. Copies of this file are held at the medical station and the Human Resources department. These documents are generally referred to as “person-job specifications” for the various occupations, and should cover both the inherent requirements of the jobs and the expected hazard exposure(s).

Step 3 – Setting standards for medical surveillance

Once occupational health risk profiles and person-job specifications are established, the occupational medical practitioner should set medical standards for each of these occupations as determined by the risk profiles. The medical examinations required to

identify the relevant exclusions (or inclusions) should be stated, with the minimum standard required.

3.11.8 Occupational health risk assessments with specific reference to Physical Work Capacity (PWC) and Functional Work Capacity (FWC)

Apart from a major “philosophical” shift, the scope of the Mine Health and Safety Act (29/1996) has been extended, rather specifically, to medical surveillance (Section 13). Primarily with regard to “employees exposed to health hazards” and actions applicable to employees rendered unfit as a result of occupational disease (Section 13(6) and (7)). Medical surveillance, in terms of its intent, is therefore nothing other than a risk-based medical examination or, quite plainly, an assessment of health risk.

At first glance, the Act addresses both medical surveillance and standards of fitness with admirable circumspection. However, on closer analysis, there are two issues that appear to have been underestimated or even ignored. These are:

- The hostility of the underground environment, especially in deep-level mines, is not restricted to traditional hazards such as dust, heat and noise, but also to the physically demanding nature of most work routines. Yet, with the exception of heat tolerance screening (HTS), the health risk of over-exertion and/or premature fatigue receives no recognition. Also the worker cannot get away from his/her working environment – even when resting, workers are still exposed. Recovery when resting is thus very little; and
- In terms of the DME Guideline on standards of fitness, “fitness” is equated, by implication, to the absence of disease. Quite obviously, this is not irrelevant but ignores the health risk associated with poor nutrition and inappropriate shift systems, for example. In this respect the only directive that may have some relevance in the MHS Act is Section 13(5): “an occupational medical practitioner must --- promote the health and safety of employees ---.”

Against the above background, it is suggested that health risk assessments that exclude the possibility of premature fatigue, over-exertion or repetitive strain injury, where such risks indeed exist, are short-sighted.

Assessment of overall fitness

The term overall fitness embraces both “medical” and “physical” fitness. Medical fitness consists of:

- satisfactory health, as determined by a general medical examination; and
- the absence of critical contra- indications or impairments as determined by a risk-based medical examination, i.e. medical surveillance.

To date the only meaningful parameter of work capacity has been restricted to an assessment of heat tolerance, with numerous mines introducing and applying exemptions based on rather questionable health risk assessments. Body mass, body mass index (BMI) and age have some bearing on work capacity but appear to have more use in establishing a risk profile than as independent indicators.

Functional Work Capacity was developed to rectify what could be considered, with hindsight, as a glaring omission. The FWC test battery assesses specific skills and abilities to perform manual work and was designed to evaluate functional abilities such as mobility, the influence of work positions and material handling.

Basic Principles

The FWC test battery consists of 19 elements simulating functional work demands. Each of these simulations has a specific workload that has to be completed in a reasonable time. In this context “reasonable” means a work rate, which can be equated to “sedentary or better”. The corresponding physiological parameters for a sedentary work are about 30-40 per cent of maximal oxygen consumption or a heart rate of about 110 beats per minute (bpm). Since oxygen consumption measurements are costly, time consuming and require special instrumentation, the basic parameter of choice is heart rate. Moreover, heart rate reflects total stress and effort; this is not always the case with oxygen measurements.

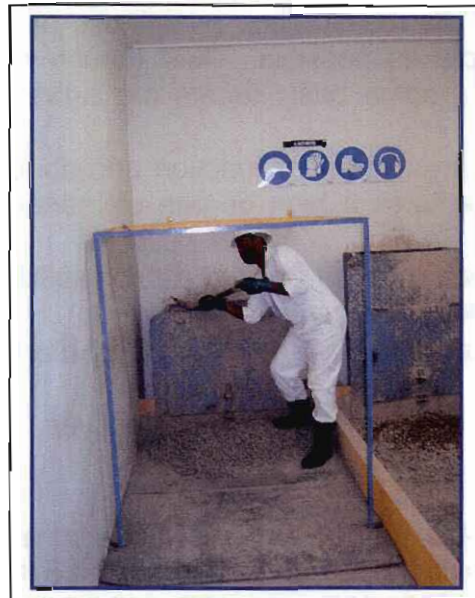


Figure 3.18: An element (restricted workplace) from the FWC test battery

To avoid premature fatigue and the onset of heat disorders, self-pacing at a moderate work intensity is probably the most important counter. In the development of the FWC test battery, therefore, the norm or standard required was set at the individual's ability to undertake full-shift work at a rate which, at the very least, can be regarded as 'moderate'. Normal healthy individuals, without any special endurance training, can generally achieve such work rates through 'self-pacing'.

Such an approach, which in effect represents the 'ethical' point of departure for setting FWC standards, is especially relevant to teams where older workers, who are generally slower, with a reduced overall work capacity, may be hard-pressed to keep up with

young members of the team ('age-neutral'). The argument could be extended to females in a 'gender-neutral' team (Kielblock & Hoffman, 2003).

3.12 Occupational health and safety management systems

When viewed as a total system, health and safety management involves three broad and interrelated domains, i.e. people, environment and systems. This is based on two underlying premises:

- health and safety are affected by all aspects of the design and workings of an organisation; and
- the design and management of health and safety systems must integrate all three domains in proportions that reflect an organisation's unique characteristics. In other words, no one system is universally effective.

Ultimately, the system should be measurable, modifiable, perceived to be positive by those it affects, and as simple as possible. And though no one system will work effectively in all organisations, some basic tenets are universal (Hethmon & Doane, 2001):

- Health and safety are a management function and should be led and managed accordingly. This necessitates a high degree of management commitment and involvement;
- Unifying elements produce a set of defined responsibilities and accountability for those activities at all levels of the organisation;
- Incidents, injuries and illnesses are an indication of a problem in the system, not simply human error; and
- Performance goals must reflect management objectives.

People

People are at the core of health and safety. As research and experience indicated, most safety incidents are behaviour related. It has been said that safety is a continuous battle with human nature but a fight that can be won with an appropriate investment in understanding people with all their capabilities, limitations, and behaviours. As such, successful health and safety management must be centred on people (Hethmon & Doane, 2001) – both labour and management. However, the human element is very complicated and dynamic, requiring constant attention and feedback.

Environment

This domain relates to the physical work space including the materials and mechanisms found therein. These are the elements of mining that can be seen and must be controlled, or at least understood, to the point of predicting how they will affect work and workers. It must be realized that studies indicate that behaviour contributes to the vast majority of accidents, but almost without exception, environmental conditions also play a contributory role.

Systems

These are the processes by which things get done. They include health and safety regulatory compliance activities, production and maintenance methods, interaction between entities within the organisation, proactive and reactive health and safety practices, social processes and programmes, human resource activities, communication mechanisms, intrinsic and extrinsic rewards, and measurement systems. The list goes on.

Organisations are designed for the results they obtain, whether it's production, safety or quality. Results are determined in large part by the systems that have been implemented based on the organisation's design and how those systems are managed.

In addition to design, a major failing of many otherwise effective systems is the lack of a renewal/reviewing phase or process. To be successful, systems must periodically be re-evaluated to determine if they are adding value, addressing problems and contributing to continuous improvement. Proper feedback provides a mechanism to enhance systems, correct those yielding poor results and eliminate those that are ineffective.

3.13 Occupational health management

Improvement in workplace conditions and decrease or elimination of illness and disability are due to actions within the workplace and result from the implementation of risk prevention and control measures. However, success may only be visible months or years later and may require interventions that have to be maintained over prolonged periods. This demands continuous, co-ordinated effort to ensure sustainability of diverse occupational health programmes and the relevant management systems.

There are many standards available to Organisations today. These standards cover the following key issues facing business worldwide:

- Product quality;
- Environment;
- Health and Safety;
- Financial accounting; and
- Sustainable development and Corporate Social Responsibility.

There is a diverse range appealing to organisations of all sizes and from all industries. Some of these standards are at the very local level targeting small to medium size enterprises within a narrow region. Others such as the ISO range of standards are much formalised and are open to all businesses. A key requirement for any standard is for the standard to be auditable, i.e. the organisation's compliance with the standard is proven by the availability of verifiable evidence.

There are a number of international standards or guidelines available on suitable structures for an OH&S or SHE management system. Examples of these are the British Standards Institute (BS8800): "Guide to Occupational Health and Safety Management

Systems”, the joint Australia / New Zealand standard (AS/NZ 4801): “Occupational Health and Safety Management Systems – Specification with guidance for use”. OHSAS 18001 and the ILO document (ILO-OSH 2001): “Guidelines on occupational health and safety management systems” are the reference documents of choice. All of these have a very similar approach and the choice of any particular standard for the individual operation would be determined by the fit with the existing management system and the local legislation.

Research into multiple national health and safety management standards has indicated that all successful systems incorporate five generic elements, namely:

- A comprehensive Occupational Health policy;
- Dynamic organising and careful planning;
- Effective implementation and operation;
- Monitoring and corrective action; and
- Conscientious management review.

The Occupational Health and Safety Assessment Series (OHSAS) specifications and the accompanying OHSAS 18002, Guidelines for the implementation of OHSAS 18001, have been developed in response to urgent customer demand for a recognisable occupational health and safety management standard against which their management system can be assessed and certified.

3.14 Occupational Health and Safety Assessment Series (OHSAS) 18001

For any organisation to establish an occupational health and safety management system the first and most important step identified by OHSAS 18001 is to carry out a review of the arrangements and procedures already in place. This process of self-assessment is known as the “initial status review” (ISR); essentially it answers the question: precisely where is the organisation now, in managing occupational health and safety issues?

The ISR helps organisations find out:

- Where they are now in managing occupational health and safety issues?
- What needs to be done? and
- What help and information are available from outside organisation?

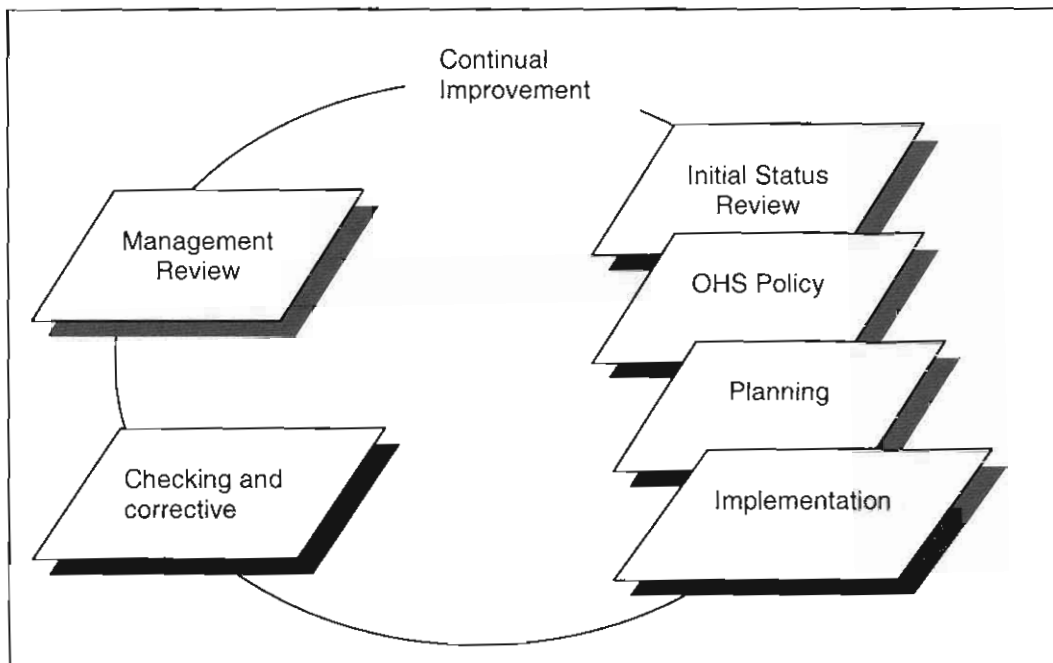


Figure 3.19. OHSAS 18001 process

OHSAS 18001 identifies four areas against which the organisation should compare its current occupational health and safety management arrangements when carrying out an ISR:

- Requirements of relevant legislation dealing with OH&S management issues,
- Existing guidance on OH&S management available within the organisation,
- Best practice and performance in the organisation's employment sector and other appropriate sections, and
- Efficiency and effectiveness of existing resources devoted to OH&S management.

3.14.1 The planning phase of OHSAS 18001 and risk assessment

OHSAS 18001 identifies three key areas, which need to be addressed during the planning stage.

- Risk assessment
 - The organisation should carry out risk assessment, including identification of hazards.
 - Risk assessment should be carried out throughout the organisation, as this is a legal requirement.
- Legal and other requirements
 - The organisation should identify the legal requirements, in addition to the risk assessment, applicable to it and also any other requirements to which it subscribes applicable to OH&S management.

- Other requirements include industry codes of practice such as the Chemical Industries Associations Responsible Care, or a voluntary code such as Investors in People.
- OH&S management arrangements

3.14.2 Planning for hazard identification, risk assessment and risk control

The organisation shall establish and maintain procedures for the ongoing identification of hazards, the assessment of risks, and the implementation of necessary control measures. These shall include:

- routine and non-routine activities;
- activities of all personnel having access to the workplace (including subcontractors and visitors);
- facilities at the workplace, whether provided by the organisation or others.

The organisation shall ensure that the results of these assessments and the effects of these controls are considered when setting its OH&S objectives. The organisation shall document and keep this information up to date.

The organisation's methodology for hazard identification and risk assessment shall:

- be defined with respect to its scope, nature and timing to ensure it is proactive rather than reactive;
- provide for the classification of risks and identification of those that are to be eliminated or controlled;
- be consistent with operating experience and the capabilities of risk control measures employed;
- provide input into the determination of facility requirements, identification of training needs and/or development of operational controls;
- provide for the monitoring of required actions to ensure both the effectiveness and timeliness of their implementation.

Intent

The organisation should have a total appreciation of all significant occupational health and safety hazards in its domain, after using the processes of hazard identification, risk assessment and risk control.

Note: Some reference documents, including BS 8800, use the term "risk assessment" to encompass the entire process of hazard identification, determination of risk, and the selection of appropriate risk reduction or risk control measures. OHSAS 18001 and OHSAS 18002 refer to the individual elements of this process separately and use the term "risk assessment" to refer to the second of its steps, namely the determination of risk.

The hazard identification, risk assessment and risk control processes and their outputs should be the basis of the whole occupational health and safety system. It is important that the links between the hazard identification, risk assessment and risk control processes and the other elements of the occupational health and safety management system are clearly established and apparent.

The purpose of this OHSAS guideline is to establish principles by which the organisation can determine whether or not given hazard identification, risk assessment and risk control processes are suitable and sufficient. It is not the purpose to make recommendations on how these activities should be conducted.

The hazard identification, risk assessment and risk control processes should enable the organisation to identify, evaluate and control its occupational health and safety risks on an ongoing basis.

In all cases, consideration should be given to normal and abnormal operations, including maintenance (routine and breakdown), within the organisation, and to potential emergency conditions.

The complexity of hazard identification, risk assessment and risk control processes greatly depends on factors such as the size of the organisation, the workplace situations within the organisation, and the nature, complexity and significance of the hazards. It is not the purpose of OHSAS 18001:1999 to force small organisations with very limited hazards to undertake complex hazard identification, risk assessment and risk control exercise.

The hazard identification, risk assessment and risk control processes should take into account the cost and time of performing these three processes, and the availability of reliable data. Information already developed for regulatory or other purposes may be used in these processes. The organisation may also take into account the degree of practical control it can have over the occupational health and safety risk being considered. The organisation should determine what its occupational health and safety risks are, taking into account the inputs and outputs associated with its current and relevant past activities, processes, products and/or services.

An organisation with no existing occupational health and safety management system can establish its current position with regard to occupational health and safety risks by means of an initial review. The aim should be to consider all occupational health and safety risks faced by the organisation, as a basis for establishing the occupational health and safety management system. An organisation may wish to consider including (but not limiting itself to) the following items within its initial review:

- legislative and regulatory requirements;
- identification of the occupational health and safety risks faced by the organisation;
- an examination of all existing occupational health and safety management practices, processes and procedures;
- an evaluation of feedback from the investigation of previous incidents, accidents and emergencies.

A suitable approach to the initial review can include checklists, interviews, direct inspection and measurement, results of previous management system audits or other reviews depending on the nature of the activities.

It is emphasized that an initial review is not a substitute for the implementation of the structured systematic approach.

3.14.3 Typical inputs

Typical inputs include the following items:

- Occupational health and safety legal and other requirements;
- Occupational health and safety policy;
- Records of incidents and accidents;
- Non-conformances;
- Occupational health and safety management system audit results;
- Communications from employees and other interested parties;
- Information from employee occupational health and safety consultations, review and improvement activities in the workplace (these activities can be either reactive or proactive in nature);
- Information on best practice, typical hazards related to the organisation, incidents and accidents having occurred in similar organisations;
- Information on the facilities, processes and activities of the organisation, including the following:
 - details of change control procedures;
 - site plan(s);
 - process flow-charts;
 - inventory of hazardous materials (raw materials, chemicals, wastes, products, sub-products);
 - toxicology and other occupational health and safety data;
 - monitoring data;
 - workplace environmental data.

3.14.4 Process

a) Hazard identification, risk assessment and risk control

i) General

Measures for the management of risk should reflect the principle of the elimination of hazards where practicable, followed in turn by risk reduction (either by reducing the likelihood of occurrence or potential severity of injury or damage), with the adoption of personal protective equipment (PPE) as a last resort. Hazard identification, risk assessment and risk control processes are key tools in the management of risk.

Hazard identification, risk assessment and risk control processes vary greatly across industries, ranging from simple assessments to complex quantitative analyses with extensive documentation. It is for the organisation to plan and implement appropriate hazard identification, risk assessment and risk control processes that suit its needs and its' workplace situations, and to assist it to conform to any OH&S legislative requirements.

Hazard identification, risk assessment and risk control processes should be carried out as proactive measures, rather than as reactive ones, i.e. they should precede the introduction of new or revised activities or procedures, new materials and chemicals,

new machines, etc. Any necessary risk reduction and control measures that are identified should be implemented before the changes are introduced.

Hazard identification, risk assessment and risk control processes should not only be applied to "normal" operations of plant and procedures, but also to periodic or occasional operations/procedures such as plant cleaning and maintenance, or during plant start-ups/shut-downs and breakdowns.

The existence of written procedures to control a particular hazardous task does not remove the need for the organisation to continue to perform hazard identification, risk assessment and risk control processes on that operation.

As well as considering the hazards and risks posed by activities carried out by its own personnel, the organisation should consider hazards and risks arising from the activities of contractors and visitors, and from the use of products or services supplied to it by others.

ii) Hazard identification, risk assessment and risk control processes

The hazard identification, risk assessment and risk control processes should be documented and should include the following elements:

- identification of hazards;
- evaluation of risk with existing (or proposed) control measures in place (taking into account exposure to specific hazards, the likelihood of failure of the control measures, and the potential severity or consequences of injury or damage);
- evaluation of the tolerability of residual risk;
- identification of any additional risk control measures needed;
- evaluation of whether the risk control measures are sufficient to reduce the risk to a tolerable level.

Additionally, the processes should include the definition of the following items:

- the nature, timing, scope and methodology for any form of hazard identification, risk assessment and risk control that is to be used;
- applicable occupational health and safety legislation or other requirements;
- the roles and authorities of personnel responsible for performing the processes;
- the competency requirements and training needs for personnel who are to perform the processes. (Depending on the nature or type of processes to be used, it may be necessary for the organisation to use external advice or services);
- the use of information from employee occupational health and safety consultations, review and improvement activities (these activities can be either reactive or proactive in nature);
- how consideration should be given to the risk of human error within the processes being examined;
- the hazards posed by materials, plant or equipment that degrade over time, particularly when such materials, plant, or equipment is in storage.

iii) Subsequent actions

Following the performance of the hazard identification, risk assessment and risk control processes:

- there should be clear evidence that any corrective or preventive actions identified as being necessary are monitored for their timely completion (these may require that further hazard identification and risk assessments be conducted, to reflect proposed changes to risk control measures and to determine revised estimates of the residual risks);
- feedback on the results, and on progress in the completion of corrective or preventive actions, should be provided to management, as input for management review and for the establishment of revised or new occupational health and safety objectives;
- the organisation should be in a position to determine whether the competency of personnel performing specific hazardous tasks is consistent with that specified by the risk assessment process in establishing the necessary risk controls;
- feedback from subsequent operating experience should be used to amend the processes, or the data on which they are based, as applicable.

b) Review of hazard identification, risk assessment and risk controls

The hazard identification, risk assessment and risk control process should be reviewed at a pre-determined time or period as set out in the occupational health and safety policy document or at a time pre-determined by management. This period can vary depending on the following considerations:

- the nature of the hazard;
- the magnitude of the risk;
- changes from normal operation;
- changes in feedstocks, raw materials, chemicals, etc.

The review should also take place if changes within the organisation call into question the validity of the existing assessments. Such changes can include the following elements:

- expansion, contraction, restructuring;
- reapportioning of responsibilities;
- changes to methods of working or patterns of behaviour;
- complaints; and
- legal/statutory changes.

c) Typical outputs

There should be documented procedure(s) for the following elements:

- identification of hazards;
- determination of the risks associated with the identified hazards;
- indication of the level of the risks related to each hazard, and whether they are, or are not, tolerable;
- description of, or reference to, the measures to monitor and control the risks, particularly risks that are not tolerable;

- where appropriate, the OH&S objectives and actions to reduce identified risks, and any follow-up activities to monitor progress in their reduction;
- identification of the competency and training requirements to implement the control measures;
- necessary control measures should be detailed as part of the operational control element of the system;
- records generated by each of the above-mentioned procedures.

d) Continual Improvement

- Check significant risks
The objective here is to identify those significant aspects that through better operational control or other forms of management will achieve improved business performance and reduce environmental impact. Increased monitoring and measurement will almost certainly be required.
- Compare with legal and policy requirements
It is particularly important to identify any significant aspects that have results close to the legal limits. Pending the implementation of an objective or management programme to reduce the results well below the legal limit an early warning system must be implemented to prevent the legal limit be exceeded.
- Set objectives to reduce the significance
A register of significant risks is a very useful management tool and can be used for many purposes. Management should check that reductions in risk are being generated by the management system.

In particular, it provides the basis for setting objectives and the means of demonstrating continuous improvement.

3.15 Integrated management systems

International experts consider integration of the occupational health management system with the other management systems within an organisation to be essential for its success. Some organisations may see benefits in complete integration of the various systems by integrating organisational structures, strategic decision-making, resource allocation, and the processes of auditing and reviewing performance. Other organisations may prefer different methods and extents of integration, depending on their size and complexity and the grouping of systems with similar management principles (Guild, 2001). However, the case for integrated management systems (IMS) appears overwhelming. The management processes in the health, safety, environmental and quality areas are, in principle, the same and are focused on achieving designated performance standards. They typically involve some element of risk assessment, and the selection of technical, behavioural, organisational and procedural controls. Thus, integrated management is necessary, at least for work procedures for health, safety, environmental and quality requirements. In addition, the Occupational Health management system must be compatible with the other

management systems in the organisation. Organisations with an effective IMS should be able to perform optimally when challenged by many different risks and uncertainties. It should lead to:

- less duplication of effort;
- development of procedures that are optimally designed to take into account the needs of each discipline; and
- avoidance of compartmentalisation of expertise.

Although the benefits of integration are attractive, the process of integration is not straightforward. Integration could increase the complexity of systems that are already perceived as over-bureaucratic. Furthermore, tension and misunderstanding may arise between specialists in occupational health and in the other areas and philosophical differences in approach could lead to damaging repercussions. Integration could also worsen the tendency for specialists in one discipline to underestimate the challenges of others. Organisations should consider in what circumstances an IMS could lead to inappropriate resource allocation, inefficiency and inflexibility. A well planned system should be efficient and allow optimal decision making in the face of a range of uncertainties. The process of integration presents distinctive challenges for different organisations and five issues should be evaluated carefully before considering integration:

- the case in favour of integrating management systems
- arguments for retaining largely independent systems
- organisational pre-requisites for integration
- factors that should be considered when introducing an integrated management system; and
- the maintenance and development of an integrated management system.

Organisations most likely to succeed in integrating their systems, already possess multiple channels of communication founded on trust, respect for the expertise of colleagues, and confidence in the management of change.

Effective health and safety management must include acknowledging the importance of occupational health hazards and the proportionate application of resources to address those issues. Occupational health cannot be managed in isolation. It must be part of an integrated occupational safety and health (OSH) or safety, health and environment (SHE) management system or any sustainable development initiative. This, in turn, must be seamlessly integrated into the general management system of the company. The primary responsibility for health and safety lies with a particular operating company's management, who should ensure that the systems and resources are adequate to meet the occupational health needs of the company. Occupational health and safety professionals provide specialist input as required. The system should be a dynamic one built around clear objectives, a defined approach to acceptable risk, clear communication and a commitment to continuous improvement. The occupational health service provider, whether outsourced or internal, should have a direct line of communication to the chief operating officer or equivalent of the company concerned.

CHAPTER 4: OCCUPATIONAL HEALTH RISK ASSESSMENT PROCESSES

4.1 Occupational health risk assessment – South Africa background

The first recognised legal reference in national legislation on occupational health can be found in Section 7 of the Precious Stones and Mineral Mining Rights Act of the Cape of Good Hope, Act 19 of 1883, which mentioned “the protection of life and limb”. Safety and health regulations were also contained in Section 45 of the ZAR Law 3 of 1893. Occupational hygiene was mentioned in more detail in the first Mines and Works Act, Act 13 of 1911. The first Factories Act, Act 28 of 1918, made provision for the control of health risks in industrial buildings. This act was later amended and was known for years as the Factories, Machinery and Building Works Act, Act 22 of 1941 (SAIOH, 2001).

However, it was in 1975 that occupational hygiene received the necessary attention in the form of the Erasmus Commission of Inquiry into Occupational Health (ASOSH, 2001).

In the Commission's report, the following was indicated:

- most managers are not conscious of industrial health and are not committed to promoting the concept;
- managers apparently pay little heed to factory inspectors;
- managers seldom appoint people to promote the prevention of industrial disease;
- sisters and nurses are often employed in industry, but they have insufficient knowledge of industrial health;
- the situation with regard to occupational hygiene is acute;
- workers are ignorant of the health hazards of the substances they handle;
- the control of hazardous substances, and of the gases and fumes being released in the manufacturing processes, is inadequate; and
- the training of occupational hygienists has been seriously neglected.

This report was probably of cardinal importance with regard to the amendments made to the Factories Act and the publication of the Machinery and Occupational Safety Act (6/1983) and the subsequent Occupational Health and Safety Act (85 /1993).

The South African minerals industry has entered a period of renewed social responsibility following the findings of the 1994 Leon Commission of Enquiry into health and safety and the promulgation of the Mine Health and Safety Act in 1996 and the Occupational Hygiene Regulations in this Act in 2002.

The Commission found that over 69 000 mine workers had died in the first 93 years of the 20th century, and more than a million were seriously injured (ASOSH, 2001). Other accident statistics indicated that:

- 1,54 mineworkers were killed and 25,8 seriously injured for every 1000 workers exposed to underground risk work;
- the vast majority of injuries and deaths occurred at or in underground mines (99%);
- gold mines are the most dangerous, accounting for 85,6 % of all reported injuries and 72,7 % of all reported fatalities;
- 61,7 % of gold mining fatalities were due to underground rock bursts or rock falls;
- the second most dangerous sub-sector was the coal industry which was responsible for 15,4 % of all mine fatalities; and
- when compared to 19 other countries, South Africa had the sixth highest fatality rate.

In its investigations the Leon Commission sketched the following occupational health experience of miners (ASOSH, 2001):

- tuberculosis rates of 58 per thousand after 15 years of exposure;
- shaft sinkers and stopers working 8 000 shifts have more than 30 % probability of developing silicosis;
- 25 % of the workforce would develop asbestos-related diseases including lung cancer after 20 years of exposure in an asbestos mine;
- 50 – 60 % of the workforce would develop coal miner's pneumoconiosis after 40 years of exposure; and
- 40 – 80 % of workers involved in drilling operations would have hearing problems after 10 years of exposure.

The main emphasis and focus of occupational health activity on the Mines has thus been on regulating the compensation for occupational diseases rather than the prevention thereof. The Minerals Act (50/1991) focused predominantly on the safety issues in the mining industry with no emphasis on promoting the occupational health status of workers. These deficiencies provided the impetus for the Commission recommending the following:

- drafting of a new Mine Health and Safety Act to provide the comprehensive legal framework for creating a healthy and safe working environment;
- restructuring of the enforcement agency;
- promulgating of regulations on rock falls and rock bursts;
- promulgating of regulations and protective measures to protect the health of workers including occupational hygiene and medical surveillance programmes with specific reference to tuberculosis;
- restructuring of research institutions and health information systems; and
- ensuring appropriate training and certification of all workers in the industry.

In 1995 the Leon Commission of Inquiry into Health and Safety in the Mining Industry presented a set of recommendations to the South African Cabinet, including the recommendation that a new statute on occupational health and safety in the mining industry should be drafted.

These recommendations provided the basis for a draft mine health and safety bill, which was drafted after negotiations in the Mining Regulations Advisory Council (MRAC), a tri-partite body representing stakeholders in the mining industry. The draft bill was tabled at Nedlac in December 1995. As a result of the extensive negotiations in the MRAC, the bill was not subjected to substantial negotiations in Nedlac. A committee of principles was established to consider the bill and certain amendments were made, where after Nedlac gave its support to the passage of the bill through Parliament. The bill was passed into law by Parliament in May 1996.

The Mine Health and Safety Act aims to redress the poor health and safety record of the South African mining industry, and to avoid a repetition of tragedies such as the Kinross and Vaal Reefs disasters. The Act, among others, grants workers the right to refuse to perform work under dangerous conditions, something deemed to make the Mine Health and Safety Act superior to its counterpart, the Occupational Health and Safety Act, and to elect their own safety representatives. The Act also imposes extensive obligations on the owners and managers of mines regarding the health and safety of mine employees, as well as all other persons who may be directly affected by mining activity. Another key feature of the Act is that it provides for the establishment of a national health and safety inspectorate (NEDLAC, 2001).

Several key occupational health issues are central to this Act:

- health and safety are the joint responsibility of the employer, employee and State;
- employers and employees are required to identify hazards and minimise related risks;
- equipment manufacturers, suppliers and maintainers are responsible for the supply of “fit for purpose” equipment;
- routine measurement of hazard exposure is crucial to the management of health and safety; and
- health and safety training is essential to be able to assume responsibility for the identification and minimisation of risks.

A central concept arising from the Mine Health and Safety Act is the need to address occupational health issues from a systems perspective that encompasses all aspects of the interaction of employees with the work environment (Smith, 1999).

4.2 Comparison between different occupational health risk assessment processes

To establish what the key elements (components) of a comprehensive occupational health risk assessment process are, and to obtain a holistic view of the key elements, different local (South Africa) and international occupational health risk assessment processes are compared below. The processes studied were either prescriptive (law) or acceptable best practice (mostly in the form of national guidelines). Studied sources of risk assessment processes included:

National sources

- South Africa's Mine Health and Safety Act (29/1996);
- SIMRAC Practical Guide to the Risk Assessment Process (SIMRAC, 1997);
- South Africa's Occupational Health and Safety Act (85/1993);
 - Hazardous Chemical Substances Regulations;
 - Asbestos Regulations;
 - Lead Regulations;
- South African Institute of Occupational Hygiene (SAIOH) Guide to Conducting an Occupational Health Risk Assessment (SAIOH, 1997).

International sources

- National Institute for Occupational Safety and Health (NIOSH, 2003);
- National Occupational Health and Safety Commission – Australia (NOHSC, 2005);
- Health and Safety Executive – United Kingdom (HSE, 2006);
- Occupational Safety and Health Service of the Department of Labour – New Zealand (OSH, 2005);
- Occupational Safety and Health Branch of the Labour Department of Hong Kong (Hong Kong Labour Department, 2006).

4.3 South Africa's Mine Health and Safety Act (MHSA)

Section 11 of the Mine Health and Safety Act (29/1996) require an employer to identify the hazards to health and safety to which employees may be exposed while they are at work and to assess the risks to health and safety to which employees may be exposed while they are at work. The employer must ensure that the significant hazards identified and risks assessed are recorded and those records are available for inspection by employees.

The employer, after consulting the health and safety committee at the Mine, must determine all measures including changing the organisation of work and the design of safe systems of work to:

- eliminate any identified risk;
- control the risk at source;
- minimize the risk;
- in so far as the risk remains:
 - provide for personal protective equipment; and
 - institute a programme to monitor the risk to which employees may be exposed.

The employer must periodically review the hazards identified and risks assessed, including the results of occupational hygiene measurements and medical surveillance, to determine if further elimination, control or minimization of risk is possible and consult the health and safety committee on the review.

4.4 SIMRAC Practical Guide to the Risk Assessment Process

According to the SIMRAC Practical Guide to the Risk Assessment Process (SIMRAC, 1997) a risk assessment involves identifying the hazards present in a work activity or associated with the layout of premises, the construction of machinery and so on. This is followed by an evaluation of the extent of the risk involved taking into account those precautions already being taken. The SIMRAC Guide defines a hazard is something that has the potential to cause harm. This includes substances, machines, methods of work or other aspects of work organisation, and a risk is the likelihood that the harm from a particular hazard will occur. The extent of the risk depends not only on the severity of the harm to a person but also on the number of people who will be harmed.

The SIMRAC Guide describes the following general principles that should be followed when conducting a risk assessment:

- All relevant risks and/or hazards should be systematically addressed;
 - the aim is to identify the major risks in the workplace and not obscure those risks with an excess of information or by concentrating on minor risks;
 - consider aspects of the work such as the substances or equipment used, and the work process or organisation which have the potential to cause harm;
 - take into account what safety controls and other measures already exist. The effectiveness of these controls needs to be carefully reviewed;
 - be systematic in looking at hazards and risks. Remember that risk assessment is a process; and
 - it should be ensured that all aspects of the work activity are reviewed.
- The risk assessment should address what actually happens in the workplace during the work activity;
 - actual practice may differ from what is supposed to happen in written instructions, procedures, etc. This is frequently the way risk creeps into an operation unnoticed;
 - especially consider non-routine operations, for example, maintenance operations, breakdowns, shutdowns and changes in methods of work; and
 - pay attention to interruptions or changes to the workplace (equipment, substances or methods of work and people) as these are frequent causes of accidents. Changes need to be carefully managed.
- All employees and those who may be affected must be considered, including maintenance staff, security guards, visitors and contractors;
- The risk assessment should highlight those groups and individuals who may particularly be at risk such as the young and inexperienced, and those who are required to work alone or who have disabilities;
- The risk assessment process should take into account the existing safety measures and controls for example, codes of practice, procedures, guards and special instructions. These may be adequate to reduce the risk sufficiently so that the law can be complied with, but they may not be working properly. It is particularly important that this is objectively assessed;
- The level of detail on a risk assessment should match the level of risk. The purpose is not to deal with every minor hazard. A suitable and sufficient risk assessment

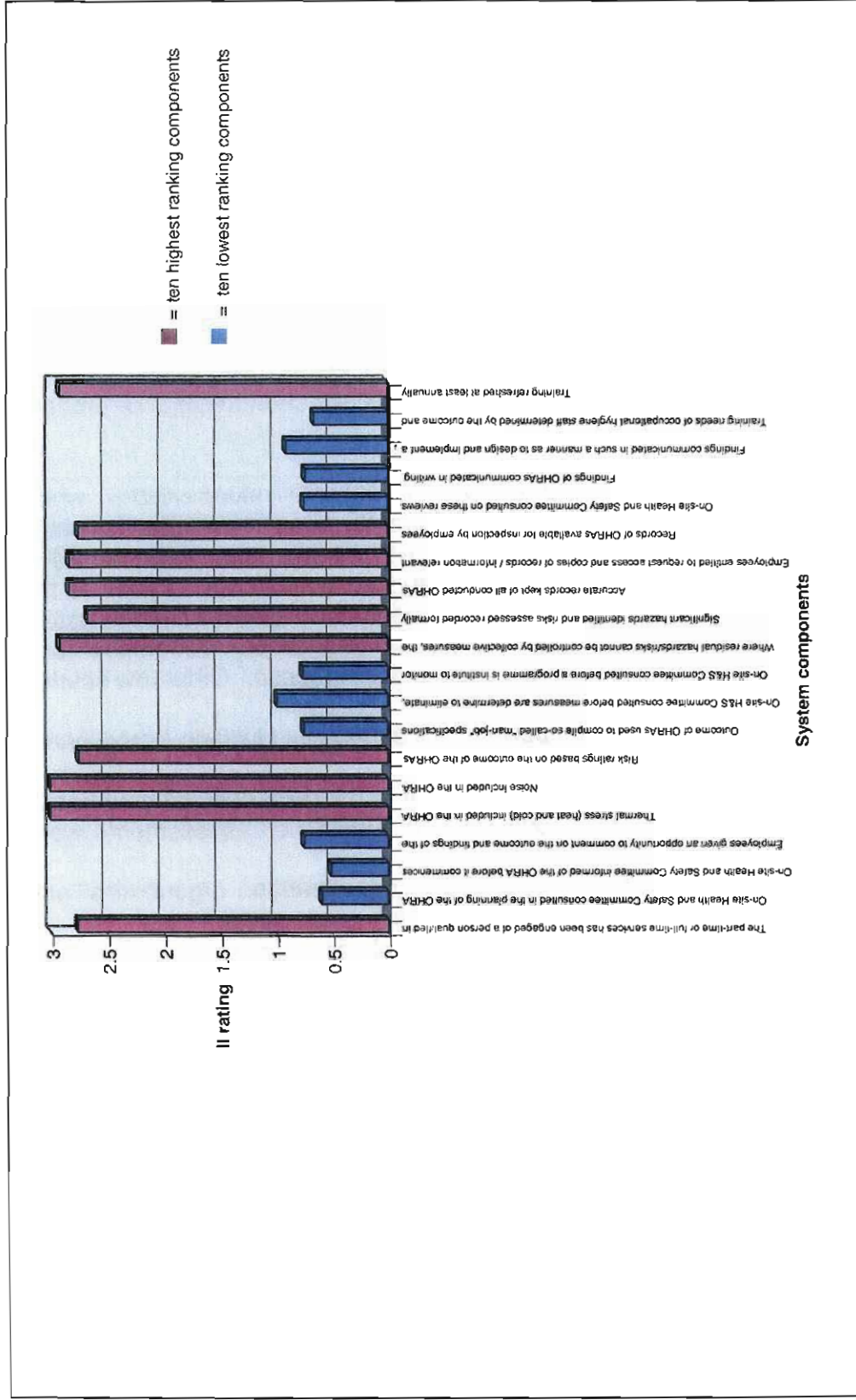
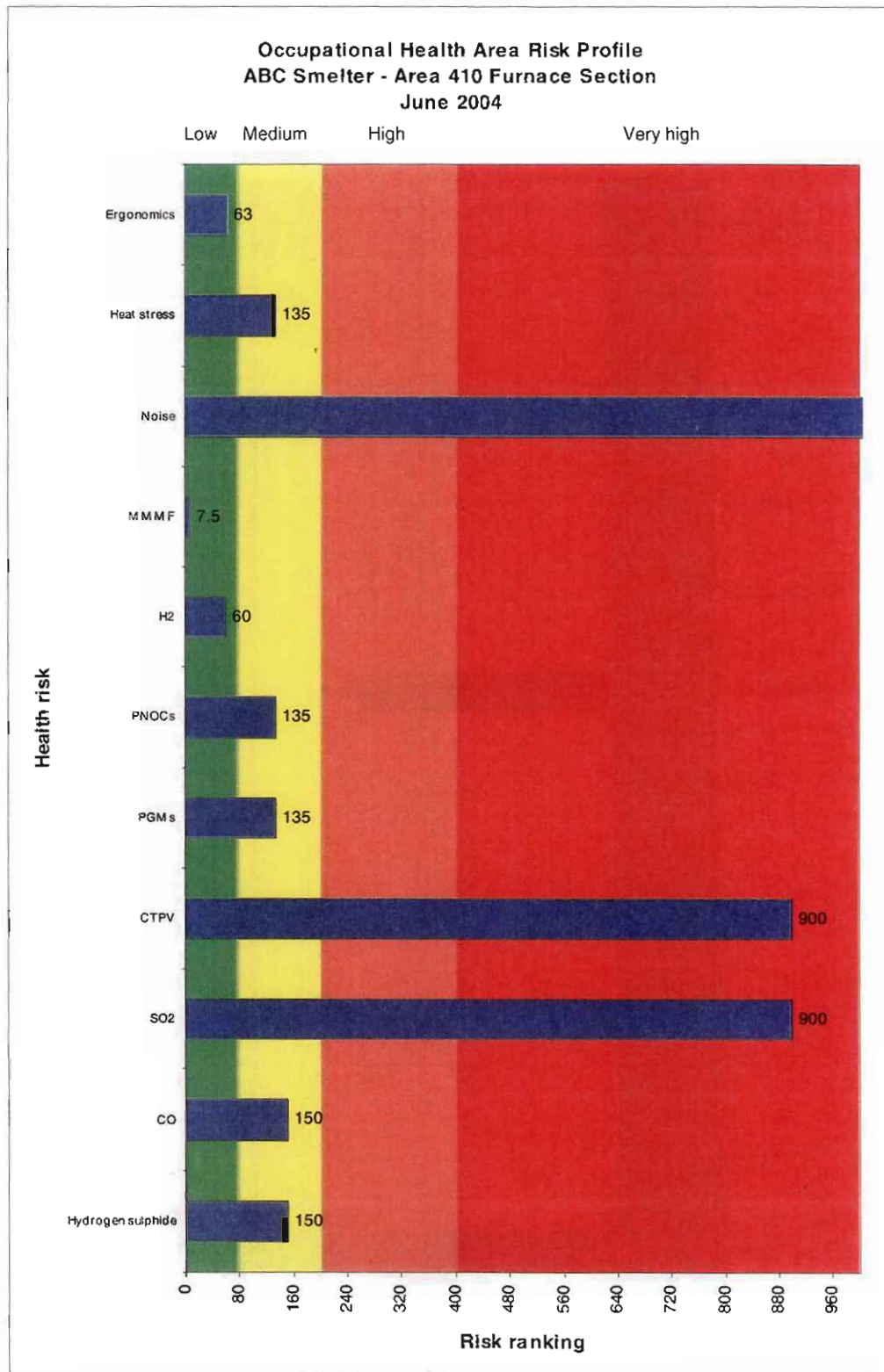


Figure 5.3. Graph reflecting the comparison between the element components of assessed OHRA processes with the ten highest and the ten lowest II rating values

6.4.2 Furnace production section of a platinum smelter



1) OCCUPATIONAL HEALTH HAZARDS					
AIRBORNE POLLUTANTS (CHEMICAL HAZARDS)					
	Category	YES	NO	RECORDED VALUE	Additional Questions or Comments
Are any of the following chemicals present in the area?					
A	Irritants which only affect the upper respiratory tract:				
1	Aldehydes (e.g. Acetaldehyde, Acrolein, Formaldehyde, etc)				
2	Alkaline dusts and mists				
3	Ammonia				
4	Chromic acid				
5	Ethylene oxide				
6	Hydrochloric acid fumes				
7	Hydrofluoric acid fumes				
8	Sulphur dioxide				
9	Sulphur trioxide				
B	Irritants which affect the upper respiratory tract and the lung tissue:				
1	Halogens (e.g. Bromine, chlorine, fluorine, iodine, etc)				
2	Chlorine oxides				
3	Cyanogen bromide				
4	Cyanogen chloride				
5	Dimethyl sulphate				
6	Ozone				
7	Sulphuric chlorides				
8	Phosphorus trichloride				
9	Phosphorus pentoxide				
C	Irritants which affect mainly the terminal respiratory passages and air sacs:				
1	Arsenic trichloride				
2	Nitrogen dioxide				
3	Phosgene				
D	Simple asphyxiants				
1	Acetylene				
2	Argon				
3	Carbon dioxide				
4	Ethane				
5	Helium				
6	Hydrogen				
7	Neon				
8	Nitrogen				
9	Nitrous oxide				
E	Chemical asphyxiants				
1	Carbon monoxide				
2	Cyanogen				
3	Hydrogen cyanide				
4	Nitriles (inhibit oxidation enzymes)				
5	Aniline				
6	Methyl and dimethyl aniline				
7	Toluidine				
8	Nitro-benzene				
9	Hydrogen sulphide				

PHYSICAL HAZARDS					
A	Ionizing Radiation				
1	Are any sources of Ionizing radiation present in the area?				
	Which?				
2	Beams				
3	x-ray cabinet				
4	Isotopes				
5	Beta Emitter				
6	Alpha Emitter				
7	Electron Microscope				
8	Other				
9	Permits for the sources?				
10	Is a monthly Radiation checks performed?				Date last survey:
11	Any employees in a Film Badge/TLD program?				
12	Are radiation-warning signs posted in radiation areas?				
13	Is annual Radiation training presented?				Date last survey:
14	Are Radiation training provided for new and transferred Employees?				
B	Non-Ionizing Radiation				
1	Are any sources of Non-Ionizing Radiation present in the area?				
	Which of the following (60Hz) Electromagnetic fields sources is present in the area?				
2	High voltage work area/test cage				
3	Transformers				
4	Computers				
5	Other				
	Which of the following Radio Frequency/microwave sources is present in the area?				
6	Microwaves				
7	Infrared (e.g. molten glass, furnaces, etc.)				
8	Ultraviolet (e.g. welding)				
9	Induction (e.g. static electricity – electromagnetic action)				
10	Other				
C	Thermal Stress				
1	Are any of employees routinely exposed to extremely hot working environments?				
2	Are any of employees routinely exposed to extremely cold working environments?				
D	Vibration				
	Are any employees routinely exposed to vibration hazards (e.g., jackhammers, grinding wheels, portable drills, etc.)?				
E	Lasers – Class I – IV				
1	Are there any lasers in the area?				
	If yes, which of the following sources are present and what Class i-iv are they?				
2	Welding				Class of Laser:
3	Construction				Class of Laser:
4	Surveying				Class of Laser:
5	Cutting				Class of Laser:
6	Alignment Devices				Class of Laser:
7	Extruder				Class of Laser:
8	Microscopes				Class of Laser:
9	Are Laser safety glasses used?				

[Ops]	OCCUPATIONAL HEALTH RISK ASSESSMENT [Sampling area & Activity area]	REF # :
		REV # : [X.X]
		DATE :

4 WORKPLACE ASSESSMENT

HEG	OCCUPATIONS	MAIN TASKS	WORK CYCLES	DME OCCUPATION CODE (if applicable)
		[Workplace]		
		[Workplace]		

[Ops]	OCCUPATIONAL HEALTH RISK ASSESSMENT [Sampling area & Activity area]	REF # :
		REV # : [X.X]
		DATE :

5 HAZARD IDENTIFICATION

	IDENTIFIED HEALTH HAZARD	TYPE OF HAZARD	NATURE OF HAZARD	ROUTE OF ENTRY	FREQUENCY OF EXPOSURE	ASSOCIATED ILL HEALTH EFFECTS	SOURCE OF EXPOSURE

<i>[Ops]</i>	OCCUPATIONAL HEALTH RISK ASSESSMENT <i>[Sampling area & Activity area]</i>		REF # :
			REV # : <i>[X.X]</i>
			DATE :

6. HAZARD EVALUATION

HEALTH HAZARD	OEL * TWA ** Short term (MHSA)	MINIMUM STANDARD LEVEL (Illumination)	RECORDED LEVEL *TWA ** Short term *** Spot sample	ADDITIONAL INFORMATION

[Ops]	OCCUPATIONAL HEALTH RISK ASSESSMENT [Sampling area & Activity area]	REF # :
		REV # : [X.X]
		DATE :

8 CURRENT CONTROL MEASURES

ELIMINATION, SUBSTITUTION OR CHANGES AT SOURCE			
CONTROL	✓	DESCRIPTION	EFFECTIVENESS
Elimination and / or substitution			
Process changes or modifications			
Reduction of number of HCS			
Changes in the physical form of HCS			
ENGINEERING CONTROL MEASURES			
CONTROL	✓	DESCRIPTION	EFFECTIVENESS
Isolation			
Total or partial enclosure			
Screening			
Local extraction ventilation systems			
Dilution ventilation systems			
Wet methods			
ADMINISTRATIVE CONTROL MEASURES			
CONTROL	✓	DESCRIPTION	EFFECTIVENESS
Shift arrangements			
Limit number of exposed employees			
Limit time spend in area			
Safe work procedures			
Supervision			
Information, training & awareness			
Provision of hygiene facilities			
Information and/or demarcation signs			

[Ops]	OCCUPATIONAL HEALTH RISK ASSESSMENT [Sampling area & Activity area]		REF # :
			REV # : [X.X]
			DATE :

MAINTENANCE OF EQUIPMENT					
CONTROL		✓	DESCRIPTION	EFFECTIVENESS	
Regular equipment inspections					
Available operating logs					
Regular equipment services					
Planned maintenance					
PERSONAL PROTECTIVE EQUIPMENT (PPE)					
PPE	TYPE	COMPLIANCE	PPE	TYPE	COMPLIANCE
Hard hat			Respiratory protection		
Foot protection			Eye protection		
Overalls					
Gloves					
Hearing protection					

[Ops]	OCCUPATIONAL HEALTH RISK ASSESSMENT [Sampling area & Activity area]	REF # :
		REV # : [X.X]
		DATE :

11 CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS	RECOMMENDATIONS
The following occupational health risks were identified as significant risks:	

PERSON-JOB SPECIFICATION

OCCUPATION GROUP:		Activity area:		Mine:	
HEG		Surface, non-risk (S)		Underground (U)	
Special category:		OREP		Other	
FUNCTIONAL REQUIREMENTS (Level of priority: 3 - High; 2 - Medium; 1 - Low; 0 - No priority)					
AREA Underground					
Climbing by means of chain ladder Climbing by means of a climbing chain Stairs					
Slopes Crawling/sloped walking Climbing over environmental obstacles Walking on uneven surfaces Climbing ability and endurance					
Surface Mobility in restricted areas, stoop walking, crawling Climbing over environmental obstacles Walking Climbing ability and endurance					
WORK TASKS Upper limb function and endurance Frequent lifting capacity Floor to knee level Knee level to above head level Lifting of loads to 25 kg Floor to knee level Knee level to shoulder level Upper limb & lower limb strength & endurance					
Making safe: barring Handling of loads: lifting Handling of loads: push/pull Lashing Pack building Work with a hammer Handling impacts on the upper limbs Functional grip strength Outer range reaching ability Upper limb endurance Dexterity (fine coordinated movements with hands					
WORK POSITION CXR Audio-grammes CXR Lung function CXR Vision screening Min Blood-lead Urinalysis ECG					
# MEDICAL EXAMINATIONS (months)* Respirator Air Stream / BA Eye Protection Face Shield Hearing Protection Particular mask Clinical examination Audiogrammes CXR Lung function CXR Vision screening Min Blood-lead Urinalysis ECG					
PPE REQUIRED Safety socks Safety shoes Gum boots Other Safety harness Safety helmet Safety glasses Safety gloves Safety boots Safety harness Safety helmet Safety glasses Safety gloves Safety boots					
ADDITIONAL NOTES Vision screening Min Blood-lead Urinalysis ECG					
EXCLUSIONS Respiratory impairment Pregnant employee Breastfeeding employee Spectacles Steel implants Infectious disease Epilepsy					
APPROVAL Name Designation Date Signature					
Other Vision Hearing Eye sight Colour Night Depth Clarity of speech Clarity to read Ability to write					

* 1 - INITIAL; 2 - PERIODICAL (6 MONTHS); 3 - PERIODICAL (12 MONTHS); 4 - PERIODICAL (24 MONTHS); 5 - (36 MONTHS); 6 - JOB OR WORKPLACE CHANGE; 7 - ACUTE EXPOSURE; 8 - EXIT

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground (Production area 1)		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2005

Carbon Monoxide	HEG S.02	Adherence to re-entry periods. Early warning systems, both personal and area.		C Low	To be determined through monitoring of airborne pollutants.	Evaluate concentrations of gas emissions.
Carbon dioxide	HEG S.02	Adherence to re-entry periods. Early warning systems, both personal and area.		C Low	To be determined through monitoring of airborne pollutants.	Evaluate concentrations of gas emissions.
Nitrogen Oxide	HEG S.02	Adherence to re-entry periods. Early warning systems, both personal and area.		C Low	To be determined through monitoring of airborne pollutants.	Evaluate concentrations of gas emissions.
Nitrogen dioxide	HEG S.02	Adherence to re-entry periods. Early warning systems, both personal and area.	Limited	C Low	To be determined through monitoring of airborne pollutants.	Evaluate concentrations of gas emissions.
Oil mist	HEG S.01 HEG D.02	Limited	Limited	C Low	To be determined through airborne monitoring.	Provision of adequate ventilation to disperse oil mists. Provision of respiratory protective device Training and awareness on PPE.
Silica quartz (Cement)	HEG S.02 (Rosond contractors)	Limited	Limited	C Low	To be determined through airborne monitoring.	

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground (Production area 1)		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2005

VAMPING AND SWEEPING				
HEG VS.01	- Slope timber - Rigger - Winch operator - Developers crew - Cleaners	Effective cleaning of working areas: winch operating: panel cleaning, material movement into panel.	Morning shift	21503 40508 40526 20701 29903
ROVING: TECHNICAL SERVICES				
HEG RT.01	- Survey - Shift controller - Planning clerks - Safety observer - Safety representatives - Senior instructor - VOHE personnel	Daily inspection, over inspections Responsible for safe operations of respective sections.	Morning shift	50202 59901 40195 20195 50899 59901 51001

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground (Production area 1)		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2005

7 OCCUPATIONAL HEALTH RISK RATING AND CLASSIFICATION (with current controls)

	HEALTH HAZARD	PROBABILITY OF EXCEEDING THE OEL (P)	EXPOSURE (E)	CONSEQUENCES (C)	NUMBER OF PERSONS (N)	RISK (PxExCxN)	RISK CLASSIFICATION	ACTION
1	Noise	6	10	2	10	1200	AA Very high	Identify and demarcate noise zones; monitor use of HPD's; Supervision over use of HPD
2	Platinum mine dust	1	6	2	10	120	C Low	
3	Carbon monoxide	0.5	2	6	3	18	C Low	Adhere to re-entry periods
4	Carbon dioxide	0.5	2	6	3	18	C Low	Adhere to re-entry periods
5	Ammonia	0.5	2	6	3	18	C Low	Provide respiratory protection; monitor use and maintenance of RPE
6	Oil Mist	1	6	2	3	36	C Low	Enforce use of RPE
7	Thermal stress (extreme heat)	6	6	3	6	648	A High	
8	Thermal stress (extreme cold)	3	3	2	3	54	C Low	
9	Welding fumes	1	6	2	2	24	C Low	Provide LEV system
10	Nitrogen dioxide	0.5	2	6	3	18	C Low	Adhere to re-entry periods
11	Nitrogen oxide	0.5	2	6	3	18	C Low	Adhere to re-entry periods
12	Silica quartz (Cement)	1	3	3	2	18	C Low	

Person/Job Specification

OCCUPATION GROUP: AREA 1.1 Underground-conventional mining									
Activity area: Stopping		Mine: ABC Mine		Date: 18 June 2005					
Activity area: Stopping		Mine: ABC Mine		Date: 18 June 2005					
Surface, non-risk (S)		Underground (U)		Hot		Cool		x	
Surface, risk (SR)		Other							
HAZARD EXPOSURE		(Risk rating: AA - Very high; A - High; B - Medium; C - Low; D - Tolerable)							
CHEMICALS									
Underground		Noise (≥ 85 dB(A))		AA		Cat's: I = Irritant; A = Asphyxiant; S = Sensitiser			
Climbing by means of a climbing ladder		Noise (≥ 105 dB(A))		AA		AN = Anesthetic/narcotic; Sys = Systemic poison			
Climbing by means of a climbing chain		Heat		0		CMT = Carcinogen/mutagen/teratogen; D = Dermatitis			
Crawling/stoop walking		Cold		2		Cat: Risk		Target organ	
Climbing over environmental obstacles		Glare		2		Oil mist		D	
Walking on uneven surfaces		Vibration (hand-arm)		AA		Skin		C	
Climbing ability and endurance		Vibration (whole body)		0					
Surface		Radiation (ionising)		0					
Mobility in restricted areas; stoop		Other		0					
Walking, crawling		Heights		0					
Climbing over environmental obstacles		Confined spaces		0					
Walking		Abnormal posture		0					
Climbing ability and endurance		Repetitive movements		0					
Stairs		Prolonged sitting		3					
Making safe; barring		Upper limb function and endurance		0					
Handling of loads: lifting		Frequent lifting capacity		2					
Floor to knee level		Prolonged standing		2					
Knee level to above head level		Shift work		2					
Lifting of loads to 25 kg		Poor lighting		0					
Floor to knee level		Uneven terrain		0					
Knuckle level to shoulder level		Handling of loads		0					
Upper limb & lower limb strength & endurance		Stress & frustration		0					
Lashing		Hard Hat		1					
Packing building		Eye Protection		0					
Work with a hammer		Face Shield		0					
Functional grip strength		Hearing Protection		1					
Outer range reaching ability		Chemical suits		0					
Upper limb endurance		Gloves		0					
Working with a spanner to loosen & fasten nuts & bolts		Particular mask		0					
Dexterity (fine coordinated movements)		Clinical examination		0					
With hands		Audio/grammes		0					
WORK POSITION		CXR		1					
Squat/kneeling		Lung function		1					
Lower limb flexibility & weight bearing ability		Min		1:3:6:8					
Stoop		Back flexibility, strength & endurance		0					
Work above head		Outer range reaching & upper limb endurance		2					
Standing on a ladder scaffold		Balance & equilibrium		0					
IMPORTANT SENSES & OTHER REQUIREMENTS		EXCLUSIONS							
Hearing		Respiratory impairment		3					
Eye sight		Pregnant employee		2					
Colour		Breastfeeding employee		1					
Night		Spectacles		0					
Depth		Other		0					
Clarity of speech		Signature		2					
Ability to read		Date		2					
Ability to write		Name		1					
Other		Designation		1					

1 - INITIAL; 2 - PERIODICAL (6 MONTHS); 3 - PERIODICAL (12 MONTHS); 4 - PERIODICAL (24 MONTHS); 5 - (36 MONTHS); 6 - JOB OR WORKPLACE CHANGE; 7 - ACUTE EXPOSURE; 8 - EXIT

TR.01	Roving: Technical services • Survey • Shift controller • Planning clerks • Safety representatives • Senior instructor • VOHE personnel	Noise	B	• Clinical examination • Audiogram • CXR • Lung function • Vision screening • Urinalysis • Questionnaire • Physical	Initial 24 months job change work place change acute exposure exit
		Platinum mine dust	D		
		CO	D		
		CO ₂	D		
		NH ₃	D		
		NO	C		
		NO ₂	D		
		Thermal stress – heat	C		
		Thermal stress – cold	D		

Signed by:

Occupational Hygienist

Occupational Medical Practitioner

ABC Smelter	OCCUPATIONAL HEALTH RISK ASSESSMENT Area – Furnace Sections		REF #: XXX
			REV: 0.0
			DATE: 24/06/2004

5.	Platinum Group metals: Rhodium, Lead, Copper, Nickel, Chromium, etc	Platinum mine dust = 3 mg/m³ Rhodium metal fume = 0,1 mg/m³ Copper Fume = 0,2 mg/m³ Nickel TWA OEL-CL for = 0,5 mg/m³ Lead, 0,15 mg/m³ Cr3+ compounds TWA OEL-RL = 0,5 mg/m³	--	<50% of OEL***	Metals cause irritation to respiratory system and eyes, dermatitis to skin. Nickel and Chrome 6+ human carcinogen.
6.	Particulates Not Otherwise Classified (PNOC's)	TWA RL= 10 mg/m ³	--	50% of OEL***	Excessive concentrations of PNOC's in the work room air may seriously reduce visibility, may cause unpleasant deposits in the eyes, ears, and nasal passages, or can contribute to injury to the skin or mucous membranes by chemical or mechanical action or by the rigorous skin cleansing procedures necessary for their removal.
7	Hydrogen gas from molten metal contact with water.	<1,4%	--	<50% of OEL***	Hydrogen is a physiologically inert gas, which is non-toxic. It is highly flammable in the presence of air and explosive if exposed to Oxygen or Chlorine. Hydrogen is a simple asphyxiant and at high concentrations, it can displace oxygen and cause asphyxiation. Oxygen content in the atmosphere must not be allowed to fall below 18%.
8	Cerablanket. MMMF isolative blanket. Shield cables from heat.	0,2 fibres/ml air	--	<50% of OEL***	Oxides of alumina and silica. Mechanical irritation to skin, eyes and upper respiratory system may result from exposure.

ABC Smelter	OCCUPATIONAL HEALTH RISK ASSESSMENT Area – Furnace Sections		REF #: XXX
			REV: 0.0
			DATE: 24/06/2004

MAINTENANCE OF EQUIPMENT						
CONTROL		✓	DESCRIPTION	EFFECTIVENESS		
Regular equipment inspections		✓	N/A	Not effective as the reasons for the conducted the inspections are not Health and Safety based		
Available operating logs						
Regular equipment services						
Planned maintenance						
PERSONAL PROTECTIVE EQUIPMENT (PPE)						
PPE	TYPE	SUITABILITY	COMPLIANCE	PPE	TYPE	COMPLIANCE
Hard hat	Normal	Yes	100%	Respiratory protection	FFP2 disposable and ABEK 1 chemical cartridge Respirators	Yes 100%
Foot protection	Steel Toe cap	Yes	100%	Eye protection	IR Protective Safety Glasses	Yes 100%
Overalls	2 Piece Normal	Yes	100%	Heat resistant clothing	Apron	Yes 100%
Gloves						
Hearing protection	Noise Clippers	Yes	80 - 100%			

ABC Smelter	OCCUPATIONAL HEALTH RISK ASSESSMENT Area – Furnace Sections		REF #: XXX
			REV: 0.0
			DATE: 24/06/2004

9. GENERAL INFORMATION

SUBJECT		DESCRIPTION	EFFECTIVENESS
MONITORING	✓	Medical surveillance is performed by the Clinic.	Medical surveillance is generic and not Risk based.
	✓	Monitoring of personal exposure to HCS is performed by site Occupational Hygienist.	
	✓		
FIRST AID FACILITIES	✓	Medical surveillance	Good
	✓	Access to first-aid box	
	✓	Available on site	
WELFARE & PERSONAL HYGIENE	✓	Access to a Clinic / First Aide station	Good
	✓	Facilities are provided and in good hygienic condition	
	✓		
	✓		
	✓		
Facilities for washing of PPE	✓	Hand washing & drinking water	
	✓	Waiting area / Green areas / Canteen	
	✓		
Storage facilities for PPE			

10. ADDITIONAL INFORMATION

None

ABC Smelter	OCCUPATIONAL HEALTH RISK ASSESSMENT Area – Furnace Sections		REF #: XXX
			REV: 0.0
			DATE: 24/06/2004

11. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS	RECOMMENDATIONS
Furnace Sections Team Members are likely to be exposed to medium risks during daily activities. The hazards include: Hydrogen sulphide, Carbon Monoxide, Sulphur Dioxide gases, CTPV's exposure as well as Platinum Group Metals and Particulates Not Otherwise Classified (PNOC's). Furthermore, physical stressors include: Noise exposure and exposure to furnace heat or molten metal when performing tapping.	• Ensure the correct use of respiratory protection and encourage the wearing of respiratory protection when required to work in plant areas. • Investigate the provision/use of extraction ventilation systems in the Plant areas to reduce the emission of gases. This will reduce the need for continuous respirator use and control the unwanted release of gases. • Ensure compliance to the wearing of HPD's among employees required to work in the Plant areas that are demarcated as noise zones. • Numerous activities generate high noise levels and employees should be trained to recognise the hazards. • Evaluate the effectiveness of used respiratory protection • Safe work procedure must be enforced where employees are exposed to high heat sources. • Medical screening to ensure fitness of employees. • PPE must be worn in demarcated areas.

12. ACTION PLAN

To eliminate / reduce the occupational health risks identified through this occupational health risk assessment, the following action has been discussed and agreed.

No	Action Required	Who responsible	Time scale
1.	Develop internal action plans to achieve recommendation results.		

A review date was agreed for the _____ at _____.

ABC Smelter	OCCUPATIONAL HEALTH RISK ASSESSMENT Area – Furnace Sections	REF #: XXX
		REV: 0.0
		DATE: 24/06/2004

13. PERSON-JOB SPECIFICATIONS

ABC Smelter	OCCUPATIONAL HEALTH RISK ASSESSMENT Area – Furnace Sections	REF #: XXX
		REV: 0.0
		DATE: 24/06/2004

14. OCCUPATIONAL HEALTH RISK ASSESSMENT RECORD FOR MEDICAL SURVEILLANCE

Person-Job Specification

OCCUPATION GROUP: AREA 410 Furnace Section				Activity area: Stopping		Operation: ABC Smelter		Date: 30 June 2004	
HEG 410A - Furnace Tappers				Surface, non-risk (S)		Underground (U)		Hot	
Special category: No				Surface, risk (SR)		Other		Cool	
FUNCTIONAL REQUIREMENTS (Level of priority: 3 - High; 2 - Medium; 1 - Low; 0 - No priority)				OREP		HAZARD EXPOSURE (Risk rating: AA - Very high; A - High; B - Medium; C - Low)			
AREA				PHYSICAL		CHEMICALS			
Underground									
Boxholes	Climbing by means of chain ladder	0		Noise (≥ 85 dB(A))	AA	Cat's: I = Irritant; A = Asphyxiant; S = Sensitiser AN = Anesthetic/narcotic; Sys = Systemic poison CMT = Carcinogen/mutagen/teratogen; D = Dermatilis	Risk	Target organ	BM?
Stopes	Climbing by means of a climbing chain	0		Noise (≥ 105 dB(A))	B				
Haulages	Crawling/stoop walking	0		Heat					
Stairs	Climbing over environmental obstacles	0		Cold					
	Walking on uneven surfaces	0		Glare					
	Climbing ability and endurance	0		Vibration (hand-arm)					
		0		Vibration (whole body)					
		0		Radiation (ionising)					
		0		Other					
		0		ERGONOMICS					
		0		Heights					
		0		Confined spaces					
		0		Abnormal posture					
		0		Repetitive movements					
		0		Prolonged sitting					
		0		Prolonged bending					
		2		Prolonged standing					
		2		Shift work					
		2		Poor illumination					
		2		Uneven terrain					
		2		Handling of loads					
		2		Stress & frustration					
		1		Harō Hāt					
		0		Eye Protection					
		1		Face Shield					
		1		Hearing Protection					
		0		Particular mask					
		1		Clinical examination					
		0		1 OH Pyrene (Urine)					
		0		Phenol (Urine)					
		1		CO (exhaled air)					
		1		Mn					
		0		Vision screening					
		0		Additional notes					
		0		EXCLUSIONS					
		3		Respiratory impairment					
		2		Pregnant employee					
		1		Breastfeeding employee					
		1		Spectacles					
		1		Other					
		2		Other					
		1		Other					
WORK TASKS Upper limb function and endurance Frequent lifting capacity Floor to knee level Knee level to above head level Lifting of loads to 25 kg Floor to knee level Knuckle level to shoulder level Upper limb & lower limb strength & endurance Upper limb function and endurance Handling loads in restricted work areas Handling impacts on the upper limbs Functional grip strength Outer range reaching ability Upper limb endurance Dexterity (fine coordinated movements with hands) WORK POSITION Lower limb flexibility & weight bearing ability Back flexibility, strength & endurance Outer range reaching & upper limb endurance Standing on a ladder/scaffold Balance & equilibrium IMPORTANT SENSES & OTHER REQUIREMENTS: Hearing Vision Eye sight Colour Night Depth Clarity of speech Ability to read Ability to write									
APPROVAL Name Designation Date Signature									

* 1 - INITIAL; 2 - PERIODICAL (6 MONTHS); 3 - PERIODICAL (12 MONTHS); 4 - PERIODICAL (24 MONTHS); 5 - (36 MONTHS); 6 - JOB OR WORKPLACE CHANGE; 7 - ACUTE EXPOSURE; 8 - EXIT

Person-Job Specification

OCCUPATION GROUP: AREA 410 Furnace Section				Activity area: Stopping		Operation: ABC Smelter		Date: 30 June 2004	
HEG 410B & 410C - Process Technician & Shift Leader				Surface, non-risk (S)		Underground (U)		Hot	
Special category: No				Surface, risk (SR)		X		Cool	
FUNCTIONAL REQUIREMENTS (Level of priority: 3 - High; 2 - Medium; 1 - Low; 0 - No priority)				OREP		HAZARD EXPOSURE (Risk rating: AA - Very high; A - High; B - Medium; C - Low)			
AREA				PHYSICAL		CHEMICALS			
Underground				Noise (≥ 85 dB(A))		Cat's: I = Irritant; A = Asphyxiant; S = Sensitizer			
Boxholes	Climbing by means of chain ladder	0		Noise (≥ 105 dB(A))		AN = Anesthetic/narcotic; Sys = Systemic poison			
Stopes	Climbing by means of a climbing chain	0		Heat		CMT = Carcinogen/mutagen/teratogen; D = Dermatitis			
Haulages	Crawling/sloot walking	0		Cold					
Stairs	Climbing over environmental obstacles	0		Glare					
	Walking on uneven surfaces	0		Vibration (hand-arm)					
	Climbing ability and endurance	0		Vibration (whole body)					
Surface				Radiation (ionising)					
Restricted work environment	Mobility in restricted areas; stoop walking, crawling	0		Other					
	Climbing over environmental obstacles	0		Heights					
Unrestricted work environment	Walking	0		Confined spaces					
Stairs	Climbing ability and endurance	0		Abnormal posture					
WORK TASKS				Repetitive movements					
Making safe: basting	Upper limb function and endurance	0		Prolonged sitting					
Handling of loads: lifting	Frequent lifting capacity	1		Prolonged standing					
	Floor to knee level	1		Shift work					
	Knee level to above head level	1		Poor illumination					
	Lifting of loads to 25 kg	1		Uneven terrain					
	Floor to knuckle level	1		Handling of loads					
	Knee level to shoulder level	1		Stress & frustration					
Handling of loads: push/pull	Upper limb & lower limb strength & endurance	1							
Lashing	Upper limb function and endurance	1							
Pack building	Handling loads in restricted work areas	0							
Work with a hammer	Handling impacts on the upper limbs	1							
	Functional grip strength	1							
	Outer range reaching ability	0							
	Upper limb endurance	1							
Working with a spanner to loosen & fasten nuts & bolts	Dexterity (fine coordinated movements with hands)	0							
Squat/kneeling	Lower limb flexibility & weight bearing ability	1							
Stoop	Back flexibility, strength & endurance	0							
Work above head	Outer range reaching & upper limb endurance	1							
Standing on a ladder/scaffold	Balance & equilibrium	0							
IMPORTANT SENSES & OTHER REQUIREMENTS									
Hearing	Eye sight	3							
Vision	Colour	2							
	Night	1							
	Depth	1							
Other	Clarity of speech	3							
	Ability to read	3							
	Ability to write	3							
PPE REQUIRED									
	Hard Hat	Yes		Respirator		Safety socks			
	Eye Protection	Yes		Air Stream / BA		Safety shoes			
	Face Shield	Yes		Overalls		Gum boots			
	Hearing Protection	Yes		Chemical suits		Other			
	Particular mask	No		Gloves		Yes			
# MEDICAL EXAMINATIONS (months)*									
	Clinical examination	1:4:6:8		1 OH Pyrene (Urine)		ECG			
	Audiogrammes	1:3:6:8		Phenol (Urine)		Urinalysis			
	CXR	1:4:6:8		CO (exhaled air)		Blood-lead			
	Lung function	1:4:6:8		Mn		Questionnaire			
	Vision screening	1:4:6:8		Vision screening		Physical			
ADDITIONAL NOTES									
EXCLUSIONS									
	Respiratory impairment	Yes		Pacemaker		Epilepsy			
	Pregnant employee	Yes		Steel implants		Fear of heights			
	Breastfeeding employee	Yes		Spectacles		Other			
APPROVAL									
	Name	Designation	Date			Signature			

* 1 - INITIAL; 2 - PERIODICAL (6 MONTHS); 3 - PERIODICAL (12 MONTHS); 4 - PERIODICAL (24 MONTHS); 5 - (36 MONTHS); 6 - JOB OR WORKPLACE CHANGE; 7 - ACUTE EXPOSURE; 8 - EXIT

OCCUPATIONAL HEALTH RISK ASSESSMENT RECORD FOR RISK BASED MEDICAL SURVEILLANCE

OPERATION: ABC Smelter

AREA: AREA 410 Furnace Section

HEG	EXPOSED OCCUPATIONS	IDENTIFIED RISKS	RISK RATING	RECOMMENDED TESTS	TEST INTERVAL
410A	Furnace Tappers	Hydrogen sulphide	B	Clinical examination	Initial
		Carbon Monoxide	B	Audiogramme	12 months
		Sulphur Dioxide	AA	CXR	job change
		CTPV's	AA	Lung function	work place change
		Platinum Group Metals	B	Vision screening	
		PNOC's	B	Urinalysis	
		Hydrogen	C	Questionnaire	
		MMMF	C	Physical	acute exposure
		Noise	AA	Heat Tolerance Screening	exit
		Thermal stress – heat	B		
		Ergonomics	C		

410B 410C	- Process Technician - Shift Leader	Hydrogen sulphide	B	- Clinical examination - Audiogramme - CXR - Lung function - Vision screening - Urinalysis - Questionnaire - Physical	Initial
		Carbon Monoxide	B		
		Sulphur Dioxide	B		
		Platinum Group Metals	B		
		PNOC's	B		
		Hydrogen	C		
		Noise	AA		
		Ergonomics	C		
					exit
					24 months (12 months for Audiogram)
					job change
					work place change
					acute exposure

Signed by:

Occupational HygienistOccupational Medical Practitioner

Risk rating

Rating	AA	A	B	C
Risk level	Very high	High	Medium	Low

ABC Smelter	OCCUPATIONAL HEALTH RISK ASSESSMENT Area – Furnace Sections		REF #: XXX
			REV: 0.0
			DATE: 24/06/2004

15. RISK MATRIX

Occupational health risk matrix

CONSEQUENCE OF EXPOSURE (Severity of harm or damage that can occur)	
	Risk Factor
One or more mortality from an occupational disease	100
Life threatening / disabling injury or illness. Multiple occupational disease cases. Miscarriage. (very serious)	50
Irreversible health effects of concern or serious illness. Compensatable occupational disease. Possible miscarriage (serious)	15
Reversible confirmed health effects. Occupational disease	7
Minor ill health.	1

EXPOSURE (How many times people is exposed to the event and how long?)	Risk Factor
Continuous exposure for a 8 hour shift or more	10
Continuous exposure for up to 6 hours of a shift – frequent, daily	6
Continuous exposure for up to 2 hours of a shift – often, weekly	3
Short exposure periods, few times per month - seldom	2
Unusual - at least once yearly	1
Rare	0.5

PROBABILITY OF TWA EXPOSURE > OEL (What is the level of exposure?)				Risk Factor
Airborne pollutants	Noise	Thermal - Heat	Thermal - Cold	
Exposure > OEL-C or exceeding the TWA-OEL more than three fold or mixture of exposure with an index > 3	≥ 105 dB(A)	WB > 35.0 °C DB > 45.0 °C	≤ 30 °C	10
Exposure ≥ OEL-TWA ≤ three fold OEL-TWA or mixture of exposure with an index between 1 and 3	≥ 85 < 105 dB(A)	WB > 32.5 ≤ 35.0 °C DB > 37.0 ≤ 45.0 °C WBGT ≥ 30	< 5 ≥ -29 °C	6
Exposure ≥ 50% of the OEL and < OEL or mixture of exposure with an index between 0.5 and 1	≥ 82 < 85 dB(A)	WB > 29.0 ≤ 32.5 °C DB > 32.5 ≤ 37.0 °C WBGT ≥ 27 < 30	> 5 ≤ 10 °C	3
Exposure ≥ 25% of the OEL and < 50% of the OEL or mixture of exposure with an index between 0.25 and 0.5	< 82 dB(A)	WB > 27.5 ≤ 29.0 °C DB > 32.5 ≤ 37.0 °C	> 10 °C	1
Exposure ≥ 10% of the OEL and < 25% of the OEL or mixture of exposure with an index between 0.1 and 0.25		WB ≤ 27.5 °C DB ≤ 32.5 °C WBGT < 27		0.5

Risk ranking calculation

Consequence x Exposure x Probability

Above 400	AA	VERY HIGH
200 to 399	A	HIGH
70 to 199	B	MEDIUM
Below 69	C	LOW

Appendix H – OHRA: Underground diesel workshop

OCCUPATIONAL HEALTH RISK ASSESSMENT

UNDERGROUND MINING

AREA 1.1

UNDERGROUND WORKSHOPS

ABC MINE

DIESEL WORKSHOP

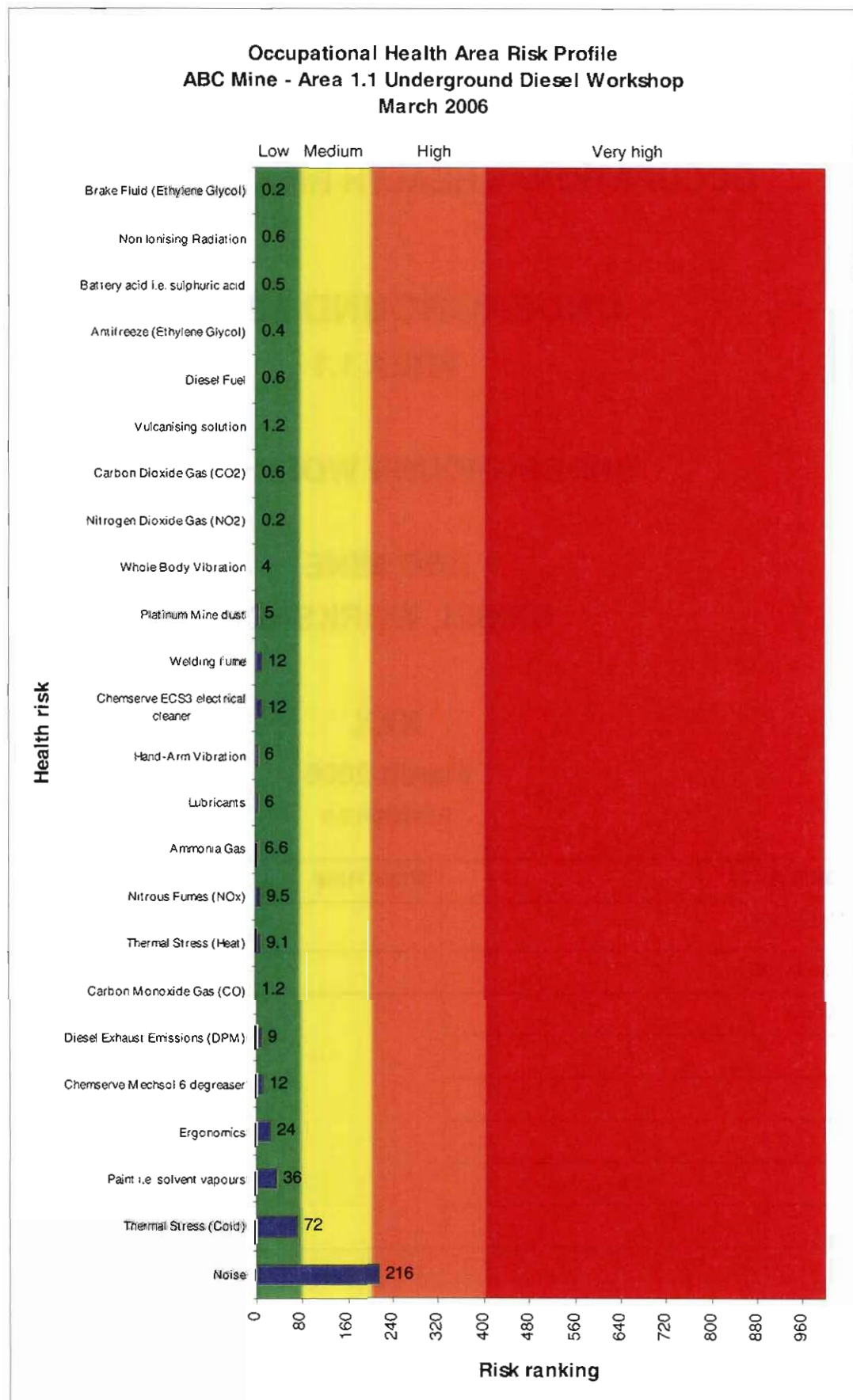
XXX

March 2006

REVISION 0.0

RESPONSIBILITY	SIGNATURE	DATE
COMPILED BY:		
REVIEWED BY:		
COPIES TO:		

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop	REF # : XXX
		REV # : 0.0
		DATE : 15/03/2006



ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop	REF # : XXX
		REV # : 0.0
		DATE : 15/03/2006

1 DECLARATION

I, A.N. Other conducted this occupational health risk assessment on behalf of the management of the ABC Mine.

The physical assessment was done over the period March 2006.

I declare that the results given in this report are a true reflection of conditions encountered during the assessment. The results only apply to conditions that existed at the time of the assessment. However, great care was taken to ensure that findings were representative of worker exposure and working conditions as specified constraints allowed for.

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A.N. Other
Occupational Hygienist
ABC Mine

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop	REF # : XXX
		REV # : 0.0
		DATE : 15/03/2006

2 CONTENTS

OCCUPATIONAL HEALTH AREA RISK PROFILE

1	DECLARATION.....	3
2	CONTENTS.....	4
3	ASSESSMENT SUMMARY.....	5
4	WORKPLACE ASSESSMENT.....	9
5	HAZARD IDENTIFICATION.....	11
6	HAZARD EVALUATION.....	14
7	OCCUPATIONAL HEALTH RISK RATING AND CLASSIFICATION.....	18
8	CURRENT CONTROL MEASURES.....	26
9	GENERAL INFORMATION.....	28
10	ADDITIONAL INFORMATION.....	28
11	CONCLUSIONS AND RECOMMENDATIONS.....	29
12	ACTION PLAN	30
13	PERSON-JOB SPECIFICATIONS	
14	OCCUPATIONAL HEALTH RISK ASSESSMENT RECORD FOR MEDICAL SURVEILLANCE	
15	RISK MATRIX	

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

3 ASSESSMENT SUMMARY

HEALTH HAZARD	EXPOSED OCCUPATIONS	EXISTING CONTROLS	EFFECTIVENESS	RISK RATING WITH CONTROL	REQUIRED CONTROL	RECOMMENDATION
Platinum Mine Dust	DC.14 - 17	Wet Drilling and moist material in stopes and on conveyance systems	Adequate	LOW	None	Encourage the wearing of disposable dust masks during dusty activities/conditions.
Ammonia	DC.14 - 17	Mine ventilation. Re-entry procedure	Partially effective	LOW	Additional ventilation and PPE controls	Prevent Ammonia trapped underneath blasted material from entering the fresh air supply to other sections as far as reasonably possible. Investigate the use of respiratory protection.
Diesel Exhaust Emissions (DEE) consisting of Diesel particulate Matter (DPM) and the gases below.	DC.14 - 17	Mine ventilation Mixed info was obtained re. air purification devices fitted to mobile equipment to remove impurities from Diesel Exhaust Emissions (DEE).	Partially effective (pending exposure quantification)	LOW	Air purification systems on vehicles. Monitoring and exposure quantification.	Install proper air filter, catalytic converter or wet scrubber systems on all vehicles to remove particulate matter from exhaust emissions. Proper fleet maintenance and raw exhaust monitoring.
Carbon Monoxide	DC.14 - 17	Natural ventilation in the workshop		LOW		
Carbon dioxide	DC.14 - 17			LOW		
Nitrogen Oxide	DC.14 - 17			LOW		
Nitrogen dioxide	DC.14 - 17			LOW		
Lubricants i.e. oils and grease	DC.14 - 17	Direct application system i.e. pumps.	Partially effective	LOW	Alternative gloves	Source alternative gloves with improved dexterity.
Brake fluid (Dot 4)	DC.15	Chemical is used in small quantities directly into application points.	Effective	LOW	None	None
Chemserve ECS3 electrical cleaner containing Perchloroethylene (50 – 70%) and white spirits (30 – 50%)	DC.16	Chemical is applied in small quantities on an intermittent and usually short duration basis. Natural ventilation present during application.	Effective	LOW	None	The chemical must always be applied under conditions of adequate ventilation.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

Chemserve Mechsol 6 degreaser containing Solvent naphtha petroleum (50 – 60%)	DC.15	Applied in outdoor, naturally ventilated areas. Applied for only short periods of time.	Effective	LOW	Respiratory protection	Encourage and allow the use of chemical cartridge respirators during high pressure application of degreaser. Allow only short application periods if no respiratory protection is used.
Vulcanising solution as trichloroethylene	DC.18	Chemical is applied in small quantities on an intermittent and usually short duration basis. Natural ventilation present during application.	Effective	LOW	None	The chemical must always be applied under conditions of adequate ventilation.
Welding metal fume and gas i.e. ▪ Iron Oxide fume ▪ Manganese fume ▪ Ozone gas	DC.17	Welding is performed intermittently, usually for short periods of time in adequately ventilated work areas.	Effective	LOW	None	The wearing of metal fume disposable dust mask should be encouraged among employees required to perform welding.
Diesel Fuel i.e. kerosene	DC.15	Exposure is limited to maintenance on the fuel lines.	Effective	LOW	None	None
Battery acid i.e. sulphuric acid	DC.16	Exposure limited to accidental spillage of acid which is unlikely since employees only add distilled water to batteries.	Effective	LOW	PPE	Issue employees with acid resistant overalls, PVC apron, acid resistant long sleeve gloves and face shield and enforce the wearing there-of during battery handling. Proper working eye wash fountains should also be situated nearby.
Paint (various types) and Plascon Thinner Lacquer Grade A containing volatile organic compounds (VOC's)	DC.15	Paint application is done infrequently for short to moderate periods of time. Only natural ventilation is present.	Only partially effective	MODERATE	PPE and Procedures	Compulsory wearing of chemical cartridge respirators during spray painting. Painting should be done after hours (prevent secondary exposure) and outdoors or under conditions of adequate mechanical ventilation.
Donaldson DCA4 Antifreeze containing mono ethylene glycol	DC.15	Physical form of the chemical reduces the risk of inhalation exposure.	Effective	LOW	None	None

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop			REF # : XXX		
				REV # : 0.0		
				DATE : 15/03/2006		

Noise	DC.14 - 17	PPE i.e. Hearing Protection Devices (HPD's)	Effective	HIGH	Engineering e.g. screens Demarcation PPE compliance	The use of mobile screens should be investigated. Identify and formally demarcate noise zones. Enforce and monitor use of HPD's.
Thermal Stress (heat)	DC.15 - 17	Mine ventilation	Adequate	LOW	None	None
Thermal Stress (cold)	DC.15 - 17	Limited exposure duration i.e. when entering and exiting the mine areas through the shafts for the majority of the employees.	Partially effective (pending exposure quantification)	HIGH	PPE controls Monitoring	Provide training to employees. Provide proper warm clothing for employees required to work in the supply air shaft areas. Provide proper warm rest areas, and allow regular resting periods. Ensure access to warm liquids Quantify actual exposure values during winter season.
Whole Body Vibration	DC.15	Good seating provided in most vehicles. Limited shock absorbing ability. Only short exposure periods.	Partially effective (pending exposure quantification)	LOW	Engineering – additional anti vibration ability for seats Monitoring	Quantify actual exposure on a representative number of employees/vehicles. Maintain proper seating. Investigate additional anti vibration mountings for vehicle seats.
Hand-arm Vibration	DC.15	None apart from short exposure periods i.e. <1hr/day	Partially effective (pending exposure quantification)	LOW	Engineering – anti vibration handles for tools PPE controls Monitoring	Quantify actual exposure on a representative number of employees. Investigate anti vibration handles on tools. Provide anti vibration gloves and enforce the wearing there-of.
Non Ionising Radiation	DC.17	Welding is performed intermittently and usually for short periods of time. Proper PPE is used whenever welding is performed.	Effective	LOW	None	Enforce the wearing of proper PPE.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

Ergonomics	DC.15	None for manual lifting and handling. None for awkward body postures and repetitive motion.	Inadequate	LOW	Administrative Training	Train and inform employees on proper body postures during static muscle loading, repetitive motion activities, lifting and manual handling techniques. Investigate implementing a formal procedure which prevents single person handling of objects heavier than 23kg. Train and inform employees on proper vehicle seating, body posture, etc. Allow regular rest periods for stretching.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

4 WORKPLACE ASSESSMENT

HEG	OCCUPATIONS	MAIN TASKS	WORK CYCLES	DME OCCUPATION CODE (if applicable)
DAY SHIFT EMPLOYEES				
DC.14	Snr. Foreman	The Foreman is responsible for the coordination, supervision and planning of maintenance on mine vehicles. Also responsible for several logistical and administrative tasks.	Day shift	40004
DC.15	- Diesel Mechanics (x4) - Assistants (x8) - Engineering Aides (x8)	The Dayshift Artisans will attend to all mechanical maintenance and services on vehicles both in the workshop and underground work areas. Maintenance is performed on Bell Dump trucks, Drill rigs, LDV's, Normets, CAT LHD's, etc. Task will mainly included removal and replacement of parts, service parts and lubrication of machines. Assistants and Aides help with lubrication, stripping of machines/parts, carrying of tools and parts, washing of parts with degreaser, etc. Will spend most of their time with the artisans.	Day shift	40477 40205 40599
DC.16	- Auto Electrician (x1) - Assistants (x2) - Engineering Aides (x2) - Boilermaker (x1) with an Assistant and Aide	The Auto Electrician Artisan will attend to all electrical maintenance on vehicles both in the workshop and underground work areas. Maintenance is performed on Bell Dump trucks, Drill rigs, LDV's, Normets, CAT LHD's, etc. Tasks will mainly included removal and replacement of parts, cleaning of electrical components with electrical cleaner and visual inspections. Assistants and Aides help with the mentioned tasks, especially the application of electrical cleaner. Will spend most of their time with the artisans. The Boilermaker will perform all metal fabrication and maintenance i.e. will perform gas cutting and welding on mainly mild steel and VRN (hardened steel) steel material. More maintenance orientated than fabrication, although a limited amount of fabrication is done intermittently.	Day shift	40319 40205 40317

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

DC.17	Boilermaker (x1) with an Assistant and Aide	The Boilermaker will perform all metal fabrication and maintenance i.e. will perform gas cutting and welding on mainly mild steel and VRN (hardened steel) steel material. More maintenance orientated than fabrication, although a limited amount of fabrication is done intermittently.	Day shift	40450 40451
DC.18	Tyre Technician (x1) (Quality Tyres contractor)	Removal repair and replacement of tyres.	Day shift	40204
SHIFT EMPLOYEES				
DC.15	Diesel Mechanic (x1/shift – total 3)	These artisans are mainly responsible for breakdown maintenance on machines both on surface and underground.	Three 8 hour shifts	40477

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

5 HAZARD IDENTIFICATION

	IDENTIFIED HEALTH HAZARD	TYPE OF HAZARD	NATURE OF HAZARD	ROUTE OF ENTRY	FREQUENCY OF EXPOSURE	ASSOCIATED ILL HEALTH EFFECTS	SOURCE OF EXPOSURE
1	Platinum Mine Dust	Chemical	Solid particles/dust	Inhalation	2 - 4 hours daily	Pneumoconiosis, dermatitis and eye irritation	Drilling, Winch operation, loading of material with LHD's, dumping of material at tips, road traffic, conveyor transfer points, belt cleaning.
2	Ammonia	Chemical	Gas	Inhalation	2 - 4 hours daily	Ammonia at high concentrations may cause severe irritation of the respiratory tract and/or chemical burns of the upper respiratory tract. Also irritating to the eyes.	Blasting emissions Charging of holes with anflex pills.
3	Diesel Exhaust Emissions (DEE) consisting of Diesel particulate Matter (DPM) and the gases below.	Chemical	Solid particles	Inhalation	2 - 4 hours daily	Occupational lung cancer, tumour induction, pulmonary irritation, irritation of the eyes and mucous membranes, etc.	Incomplete combustion in all diesel driven vehicles i.e. LHD's, UV, Grader, Dumpers, LDV's, etc.
4	Carbon Monoxide gas	Chemical	Gas	Inhalation	2 - 4 hours daily	Carbon Monoxide poisoning leading to fatigue, frequent headaches, vascular weakness, anaemia, unconsciousness and possible death due to chemical asphyxiation	
5	Carbon Dioxide gas	Chemical	Gas	Inhalation	2 - 4 hours daily	Asphyxiation - oxygen deficiency	
6	Nitrogen Dioxide gas	Chemical	Gas	Inhalation	2 - 4 hours daily	Causes eye, nose and throat irritation; drowsiness; unconsciousness and affect the central nervous system.	
7	Nitrous fumes (nitrous oxide)	Chemical	Gas	Inhalation	2 - 4 hours daily	Causes nose, throat and eye irritation; chronic bronchitis; dyspnoea; pulmonary oedema	Incomplete combustion in all diesel driven vehicles i.e. LHD's, UV, Grader, Dumpers, LDV's, etc.
8	Lubricants i.e. oils and grease	Chemical	Liquid and paste	Dermal	1-2 hours daily	Dermatitis	Blasting emissions Mechanical maintenance i.e. handling of equipment and parts covered with oil and grease. Lubrication of machines
9	Brake fluid (Dot 4)	Chemical	Liquid	Dermal	<15 minutes/week	Dermal irritation and dermatitis after prolonged dermal exposure.	Application of brake fluid from its original container.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		
	REF # : XXX		
	REV # : 0.0	DATE : 15/03/2006	

NO	IDENTIFIED HEALTH HAZARD	TYPE OF HAZARD	NATURE OF HAZARD	ROUTE OF ENTRY	FREQUENCY OF EXPOSURE	ASSOCIATED ILL HEALTH EFFECTS	SOURCE OF EXPOSURE
10	Chemserve ECS3 electrical cleaner containing Perchloroethylene (50 – 70%) and white spirits (30 – 50%)	Chemical	Liquid and vapour	Inhalation and Dermal	<1 hour daily	Short-term exposure can cause irritation of the nose and throat and central nervous system (CNS) depression. Severe skin irritant. Repeated or prolonged dermal contact is expected to cause red, itchy, dry and cracked skin (dermatitis). Organic solvent syndrome with symptoms such as dizziness, forgetfulness, inability to concentrate, mood swings, nausea and fatigue and behavioural effects such as reduced reaction time and inco-ordination.	Cleaning of electrical components and panels with the cleaner.
11	Chemserve Mechsol 6 degreaser containing Solvent naphtha petroleum (50 – 60%)	Chemical	Liquid and vapour	Inhalation and Dermal	<1 hour daily	Short-term exposure can cause irritation of the nose and throat and central nervous system (CNS) depression. Severe skin irritant. Repeated or prolonged dermal contact is expected to cause red, itchy, dry and cracked skin (dermatitis). Organic solvent syndrome with symptoms such as dizziness, forgetfulness, inability to concentrate, mood swings, nausea and fatigue and behavioural effects such as reduced reaction time and inco-ordination.	Degreasing of components using degreasing fluid applied with either a brush or high pressure washer.
12	Vulcanising solution as trichloroethylene	Chemical	Liquid and vapour	Inhalation and Dermal	<15 minutes/day	Short-term exposure causes irritation of the nose, throat and CNS depression. Severe skin irritant. Prolonged contact with the liquid has caused reddening of the skin, irritation and blister formation with repeated and prolonged contact causing dry, red and chapped skin (dermatitis). Nerves of the face and head (cranial nerves) have been affected by long-term exposure to trichloroethylene or chemicals formed when it decomposes. Trichloroethylene is probably a human carcinogen.	Patching of tyres.
13	Welding metal fume and gas i.e. ▪ Iron Oxide fume ▪ Manganese fume ▪ Ozone gas	Chemical	Fume and gas	Inhalation	1-2 hours daily	Symptoms vary depending upon the specific component of the welding fumes: metal fume fever: flu-like symptoms, dyspnea (breathing difficulty), cough, muscle pain, fever, chills; interstitial pneumonia Siderosis Manganese poisoning	Welding and gas cutting maintenance on metal equipment.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

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14	Diesel Fuel i.e. kerosene	Chemical	Liquid and vapour	Inhalation and Dermal	1.5 hours/shift	Central nervous system (CNS) depression such as headache, nausea, dizziness and light-headedness and vomiting. Moderate to severe skin irritant with prolonged exposure likely to result in dermatitis.	Maintenance on fuel lines of vehicles
15	Battery acid i.e. sulphuric acid	Chemical	Liquid	Dermal	<15 minutes daily	Sulphuric acid is not very volatile, and therefore workplace exposures are primarily to mists or aerosols. Sulphuric acid is corrosive and can cause severe irritation or corrosive damage if inhaled. Sulphuric acid can cause severe lung damage with a life-threatening accumulation of fluid (pulmonary oedema). It is corrosive and can cause severe irritation and skin burns.	Handling of lead acid batteries i.e. during charging and top up of batteries with distilled water.
16	Paint (various types) and Plascon Thinner Lacquer Grade A containing volatile organic compounds (VOC's)	Chemical	Liquid and vapour	Inhalation and Dermal	Up to 1 hour weekly	Health effects will depend on the hazardous components of each type of paint and thinners. In general it will result in Central nervous system (CNS) depression with symptoms such as headache, nausea, dizziness and light-headedness and vomiting. Components such as toluene, xylene and benzene could result in more severe and permanent health effects.	Spray paint application of mainly red-oxide and enamel type paints.
17	Donaldson DCA4 Antifreeze containing mono ethylene glycol	Chemical	Liquid	Dermal	< 30 minutes daily	Vapour concentrations are normally too low at room temperature (low vapour pressure) to cause significant toxic effects from vapour alone. Liquid may cause irritation.	Application or top-up of antifreeze
18	Noise	Physical	N/A	Ears	6 - 8 hours daily	Noise induced hearing loss. Physiological effects such as increased heart rate. Psychological effects such as increased stress	Maintenance activities, vehicles, motors, compressed air, lubrication systems e.g. grease pumps, etc.
19	Thermal Stress (heat)	Physical	N/A	Whole Body	2 - 4 hours daily	Heat stroke; heat rash; heat exhaustion and heat collapse.	Poor ventilation and natural radiation from rock.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

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20	Thermal Stress (cold)	Physical	N/A	Whole Body	1 - 2 hours daily	Systemic effects include mainly hypothermia, which manifests in the depression of the Central Nervous System (CNS). It accounts for symptoms like sluggishness, slurred speech, unsafe behaviour, disorientation and unconsciousness. Because blood flow through the skin is reduced to conserve heat, the skin and underlying tissues are more susceptible to local cold injury. Localised tissue damage. Manual Dexterity decreases with permanent skin and tissue damage as a result of prolonged exposure. Exposure to vibration further restricts blood flow (increasing risk). Frostbite or vibration white finger.	High air flow/velocities in the shafts.
21	Whole Body Vibration	Physical	N/A	Whole Body	<2 hours daily	Reported effects of prolonged whole-body vibration include dizziness, headaches, nausea, weight loss, varicose veins, blurred vision, spinal damage, rectal bleeding, haematuria, lung damage and in a few cases heart failure. Most of these effects are reversible when vibration exposure ceases. Spinal damage is the main problem for drivers.	Maintenance and testing of all vehicles
22	Hand-arm Vibration	Physical	N/A	Hand and Arms	<1hour daily	Hand-arm vibration syndrome (HAVS) is the term used to describe the injuries caused by the prolonged use of hand-held power tools. Most serious are the vascular effects, where the walls of the digital arterioles become thickened and impair the flow of blood, leading to blanching in the fingertips, palms, and thumbs, until in the final stages when blood vessels become completely blocked, gangrene may set in at the finger tips. Arc eyes, skin burn, permanent eye damage, loss of sight.	Handling and use of impact wrenches
23	Non ionising radiation	Physical	N/A	Eyes Skin	1-2 hours daily		Welding, gas cutting and gouging
24	Ergonomics	Ergonomic	N/A	Whole Body	2 - 8 hours daily	Should awkward, unnatural motions and activities be performed for prolonged periods, the physiological limitations of a worker may be exceeded, e.g. exaggerated strain (friction or pressure) on the spine, knees, elbows and hands may result in inflamed tendons, tendon sheaths and compressed nerves.	Manual lifting and manipulation of heavy equipment, moving in low slope height areas, awkward body positions during maintenance, etc.
25	Illumination	Ergonomic/Safety	N/A	N/A	8 hours during shifts	Accidents due to tripping, falling, etc.; loss of concentration; poor visibility and glare	Inadequate lighting provided in workplaces

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

6 HAZARD EVALUATION

	HEALTH HAZARD	OEL * TWA ** Short term (MHSA)	MINIMUM STANDARD LEVEL (Illumination)	RECORDED LEVEL *TWA ** Short term *** Spot sample	ADDITIONAL INFORMATION
1.	Platinum Mine Dust	3mg/m ³ (respirable dust)*	-	>10% <50% of OEL*** (0.3 – 3.72 Total dust concentrations)	The use of wet drilling and a lot of moisture in the slope and development areas during drilling is the main contributing factors to the low exposures. Loading of material and scraper winch activities may result in higher exposure levels. Engineering personnel not likely to spend prolonged periods of time near active dust generating sources.
2.	Ammonia	25ppm*	-	7 - 12ppm inside slope (day shift) Up to 51 - 67ppm*** in development end during LHD loading (day shift) with a STEL of 31 - 42ppm	Ammonia is trapped under rock after blasting i.e. gas is released during loading of material with a LHD resulting in significant concentrations. The in-slope development conditions witnessed at 4S decline section indicated that the ammonia gas being released will then form part of the "fresh" air supplied to the upper slope areas, resulting in the 7-12ppm range of ammonia gas in the slope.
3.	Diesel Exhaust Emissions (DEE) consisting of Diesel particulate Matter (DPM) and the gases below.	3.5mg/m ³ (carbon black)*	-	No quantification done.	Literature research suggests that diesel particulate matter concentrations could very likely exceed relevant standards.
4.	Carbon Monoxide gas	50 ppm*	-	Up to 49 - 67ppm STEL = 22ppm**	The measurement was obtained in a development section while a LHD was loading material at 4S decline.
5.	Carbon Dioxide gas	5000 ppm*	-	1100 - 1800 ppm**	
6.	Nitrogen Dioxide gas	3 ppm*	-	-	No available data
7.	Nitrous fumes (nitrous oxide)	25 ppm*	-	-	No available data

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

	HEALTH HAZARD	OEL • TWA ** Short term (MHSA)	MINIMUM STANDARD LEVEL (Illumination)	RECORDED LEVEL *TWA ** Short term *** Spot sample	ADDITIONAL INFORMATION
8.	Lubricants i.e. oils and grease	N/A	-	N/A	Dermal exposure not quantified, however exposure is anticipated to be regular and for moderate periods of time due to the nature of maintenance activities.
9.	Brake fluid (Dot 4)	60mg/m ³ with 125 mg/m ³ OEL-STEL	-	<10% of OEL***	The substance is not used in large quantities and in a way that will omit significant quantities of the hazardous ingredient.
10.	Chemserve ECS3 electrical cleaner containing Perchloroethylene (50 – 70%) and white spirits (30 – 50%)	335mg/m ³ with 1000 mg/m ³ OEL-STEL 575mg/m ³ with 720 mg/m ³ OEL-STEL	-	<10% of OEL***	The chemical is applied with a brush and allowed to evaporate. The employees are not necessarily present during evaporation of the chemical. The chemical is usually applied in small quantities and for short periods of time.
11.	Chemserve Mechsol 6 degreaser containing Solvent naphtha petroleum (50 – 60%)	-	-	<10% of OEL***	The chemical is applied with high pressure washers or manually with a brush or cloth. The high pressure application will disperse the chemical into the air increasing the risk of inhalation and dermal exposure. Short exposure periods however adequately reduce the risk of significant inhalation or dermal exposure.
12.	Vulcanising solution as trichloroethylene	535mg/m ³ with 802 mg/m ³ OEL-STEL	-	<10% of OEL***	The chemical is applied in small quantities in natural ventilated areas, which adequately reduces the risk of significant exposure.
13.	Welding metal fume and gas i.e. ▪ Iron Oxide fume ▪ Manganese fume ▪ Ozone gas	5 mg/m ³ 1mg/m ³ with 3 mg/m ³ OEL-STEL 0.02ppm	-	<10% of OEL***	Welding is only performed intermittently and usually for short periods of time in outdoor work areas where adequate natural ventilation will reduce exposure concentrations.
14.	Diesel Fuel i.e. kerosene	-	-	>10 <50% of OEL***	Applied directly from bulk storage tanks to vehicles once per shift. Natural ventilation present in the re-fuelling bay.
15.	Battery acid i.e. sulphuric acid	1mg/m ³ with 3 mg/m ³ OEL-STEL	-	<10% of OEL***	Exposure limited to accidental spillage or splashes during top-up of batteries with distilled water. Low vapour emission rate.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

	HEALTH HAZARD	OEL * TWA ** Short term (MHSA)	MINIMUM STANDARD LEVEL (Illumination)	RECORDED LEVEL *TWA ** Short term *** Spot sample	ADDITIONAL INFORMATION
16.	Paint (various types) and Plascon Thinner Lacquer Grade A containing volatile organic compounds (VOC's)	Variable depending on specific hazardous component	-	>50% of OEL***	Spray painting inherently result in significant exposure if proper controls are not implemented/in place.
17.	Donaldson DCA4 Antifreeze containing mono ethylene glycol	60mg/m ³ with 125 mg/m ³ OEL-STEL	-	<10% of OEL***	The chemical is applied directly from its original container into vehicles. Normal emission of vapour unlikely at normal temperatures.
18.	Noise	85 dB(A)*	-	Up to 95dB(A) inside workshop during high revving of vehicles. (dependant on activities, no of vehicles, etc.) ***	Noise is both steady state (motors) and impulsive in nature. The latter is more likely to result in noise induced hearing loss over a shorter period of time.
19.	Thermal Stress (heat)	WB: 32.5°C* DB: 37.5°C*	-	22.1*** 25.4***	The declines are not deep enough to have significant impact from rock temperatures. Average temperatures indicate average work area conditions. Engineering employees will have shorter exposure periods compared to production personnel.
20.	Thermal Stress (cold)	>4 °C Equivalent Chill temp.*	-	>0 <4EC†***	Exposure to cold conditions will be limited to the shaft areas during winter season. The engineering employees are at higher risk since they may be required to enter and exit the mines on a more frequent basis.
21.	Whole Body Vibration	-	-	Not quantified	The services of a vibration specialist should be obtained to quantify exposure among a representative number of occupations/vehicles.
22.	Hand-arm Vibration	-	-	Not quantified	The services of a vibration specialist should be obtained to quantify exposure among a representative number of occupations/vehicles.
23.	Non Ionising Radiation	10mW/cm ² *	-	Not quantified	The exposure is dependant on PPE compliance.
24.	Ergonomics	-	-	N/A	An in depth ergonomic study need to be performed on all moderate and high risk occupations identified in the assessment.
25.	Illumination	SANS 100114:1996	100	74.5 Re-illuminating Bay***	Lights only limited to outer perimeter and not between tanks. None of the provided spotlights in the yard surrounding the re-fuelling bay worked. General area in front of workshop is dark i.e. no specific lights provided.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

7 OCCUPATIONAL HEALTH RISK RATING AND CLASSIFICATION (with current controls)

HEALTH HAZARD	CONSEQUENCES (C)	EXPOSURE (E)	PROBABILITY OF EXCEEDING THE OEL (P)	RISK (CxExP))	RISK CLASSIFICATION	ACTION
DC.14 - FOREMAN						
1. Platinum Mine Dust	5	2	0.1	1	Tolerable	The low probability of exceeding the OEL is based on short and infrequent exposure durations. There is no need for urgent action re exposure associated with the foreman occupation.
2. Ammonia	2	2	0.1	0.4	Tolerable	
3. Diesel Exhaust Emissions (DEE) consisting of Diesel particulate Matter (DPM) and the gases below.	6	2	0.1	1.2	Tolerable	
4. Carbon Monoxide gas	6	2	0.1	1.2	Tolerable	The low probability of exceeding the OEL is based on short and infrequent exposure durations. There is no need for urgent action re exposure associated with the foreman occupation.
5. Carbon Dioxide gas	6	1	0.1	0.6	Tolerable	
6. Nitrogen Dioxide gas	2	1	0.1	0.26	Tolerable	
7. Nitrous fumes (nitrous oxide)	5	2	0.1	1	Tolerable	Identify and formally demarcate noise zones e.g. workshop, wash bay, etc. Enforce and monitor use of HPD's. The use of mobile screens to prevent "spillage" of noise to less noisy areas should be investigated.
8. Noise	6	3	1	18	Tolerable	

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

HEALTH HAZARD	CONSEQUENCES (C)	EXPOSURE (E)	PROBABILITY OF EXCEEDING THE OEL (P)	RISK (C×E×P)	RISK CLASSIFICATION	ACTION
HEG DC.15 – DIESEL MECHANICS, ASSISTANTS AND ENGINEERING AIDES						
9.	Platinum Mine Dust	2	0.5	5	Tolerable	Maintain proper ventilation
10.	Ammonia	6	0.5	6	Tolerable	Maintain proper ventilation
11.	Diesel Exhaust Emissions (DEE) consisting of Diesel particulate Matter (DPM) and gases below.	3	0.5	9	Tolerable	Install proper air filter, catalytic converter or wet scrubber systems on all vehicles to remove particulate matter from exhaust emissions.
12.	Carbon Monoxide gas	3	0.5	9	Tolerable	Proper fleet maintenance and raw exhaust monitoring.
13.	Carbon Dioxide gas	2	0.1	1.2	Tolerable	Limit idling and revving of vehicles to the minimum.
14.	Nitrogen Dioxide gas	2	0.5	2	Tolerable	Adhere to re-entry periods.
15.	Nitrous fumes (nitrous oxide)	3	0.5	9.5	Tolerable	Source alternative gloves with improved dexterity to ensure compliance to the wearing of gloves at all times.
16.	Lubricants i.e. oils and grease	3	1	6	Tolerable	Encourage regular washing of hands with soap and warm water and general good personal hygiene practices.
17.	Brake fluid (Dot 4)	1	0.1	0.2	Tolerable	-

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

	HEALTH HAZARD	CONSEQUENCES (C)	EXPOSURE (E)	PROBABILITY OF EXCEEDING THE OEL (P)	RISK (CxExp)	RISK CLASSIFICATION	ACTION
18.	Chemserve Mechsol 6 degreaser containing Solvent naphtha petroleum (50 – 60%)	4	3	1	12	Tolerable	Encourage and allow the use of chemical cartridge respirators during high pressure application of degreaser. Allow only short application periods if no respiratory protection is used.
19.	Diesel Fuel i.e. kerosene	2	3	0.1	0.6	Tolerable	-
20.	Paint (various types) and Plascon Thinner Lacquer Grade A containing volatile organic compounds (VOC's) e.g. Xylene.	6	2	3	36	Low	Compulsory wearing of chemical cartridge respirators during spray painting. Painting should be done after hours (prevent secondary exposure) and outdoors or under conditions of adequate mechanical ventilation.
21.	Donaldson DCA4 Antifreeze containing mono ethylene glycol	2	2	0.1	0.4	Tolerable	-
22.	Noise	6	6	6	216	High	Identify and formally demarcate noise zones. Enforce and monitor use of HPD's. Investigate engineering changes to noise sources. The use of mobile screens should be investigated.
23.	Whole Body Vibration	4	2	0.5	4	Tolerable	Quantity actual exposure on a representative number of employees/vehicles. Maintain proper seating. Investigate additional anti vibration mountings for vehicle seats.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

	HEALTH HAZARD	CONSEQUENCES (C)	EXPOSURE (E)	PROBABILITY OF EXCEEDING THE OEL (P)	RISK (C×E×P)	RISK CLASSIFICATION	ACTION
24.	Hand-arm Vibration	6	2	0.5	6	Tolerable	Quantify actual exposure on a representative number of employees. Provide anti vibration gloves and enforce the wearing there-of.
25.	Thermal Stress (heat)	6	3	0.5	9	Tolerable	
26.	Thermal Stress (cold)	6	2	6	72	Medium	Provide training to employees and provide proper warm clothing for surface employees.
27.	Ergonomics	4	2	3	24	Low	Train and inform employees on proper lifting and manual handling techniques. Investigate implementing a formal procedure which prevents single person handling of objects heavier than 23kg.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

HEALTH HAZARD	CONSEQUENCES (C)	EXPOSURE (E)	PROBABILITY OF EXCEEDING THE OEL (P)	RISK (CxExp))	RISK CLASSIFICATION	ACTION
HEG DC.16 – AUTO ELECTRICIAN, ASSISTANTS AND ENGINEERING AIDES						
28. Platinum Mine Dust	5	2	0.5	5	Tolerable	Maintain proper ventilation
29. Ammonia	2	6	0.5	6	Tolerable	Maintain proper ventilation
30. Diesel Exhaust Emissions (DEE) consisting of Diesel particulate Matter (DPM) and gases below.	6	2	0.1	1.2	Tolerable	Install proper air filter, catalytic converter or wet scrubber systems on all vehicles to remove particulate matter from exhaust emissions.
31. Carbon Monoxide gas	6	2	0.1	1.2	Tolerable	
32. Carbon Dioxide gas	6	1	0.1	0.6	Tolerable	
33. Nitrogen Dioxide gas	2	1	0.1	0.2	Tolerable	Proper fleet maintenance and raw exhaust monitoring.
34. Nitrous fumes (nitrous oxide)	5	2	0.1	1	Tolerable	Limit idling and revving of vehicles to the minimum. Adhere to re-entry periods.
35. Chemserve ECS3 electrical cleaner containing Perchloroethylene (50 – 70%) and white spirits (30 – 50%)	4	3	1	12	Tolerable	Encourage and allow the use of chemical cartridge respirators during high pressure application of degreaser. Allow only short application periods if no respiratory protection is used.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

	HEALTH HAZARD	CONSEQUENCES (C)	EXPOSURE (E)	PROBABILITY OF EXCEEDING THE OEL (P)	RISK (CxExp)	RISK CLASSIFICATION	ACTION
36.	Battery acid i.e. sulphuric acid	5	1	0.1	0.5	Tolerable	Issue employees with acid resistant overalls, PVC apron, acid resistant long sleeve gloves and face shield and enforce the wearing thereof during battery handling. Proper, working eye wash fountains should also be situated nearby.
37.	Noise	6	6	6	216	High	Identify and formally demarcate noise zones. Enforce and monitor use of HPD's. Investigate engineering changes to noise sources. The use of mobile screens should be investigated.
38.	Thermal Stress (heat)	6	3	0.5	9	Tolerable	
39.	Thermal Stress (cold)	6	2	6	72	Medium	Provide training to employees and provide proper warm clothing for surfacing employees.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

HEALTH HAZARD		CONSEQUENCES (C)	EXPOSURE (E)	PROBABILITY OF EXCEEDING THE OEL (P)	RISK (CxExpP))	RISK CLASSIFICATION	ACTION
HEG DC.17 – BOILERMAKER, ASSISTANT AND ENGINEERING AIDE							
40.	Platinum Mine Dust	5	2	0.5	5	Tolerable	Maintain proper ventilation
41.	Ammonia	2	6	0.5	6	Tolerable	Maintain proper ventilation
42.	Diesel Exhaust Emissions (DEE) consisting of Diesel particulate Matter (DPM) and gases below.	6	2	0.1	1.2	Tolerable	Install proper air filter, catalytic converter or wet scrubber systems on all vehicles to remove particulate matter from exhaust emissions.
43.	Carbon Monoxide gas	6	2	0.1	1.2	Tolerable	Proper fleet maintenance and raw exhaust monitoring. Limit idling and revving of vehicles to the minimum. Adhere to re-entry periods.
44.	Carbon Dioxide gas	6	1	0.1	0.6	Tolerable	
45.	Nitrogen Dioxide gas	2	1	0.1	0.2	Tolerable	
46.	Nitrous fumes (nitrous oxide)	5	2	0.1	1	Tolerable	
47.	Welding metal fume and gas i.e. ▪ Iron Oxide fume, Manganese fume & Ozone gas	4	3	1	12	Tolerable	Welding fume respirators should be worn whenever welding/cutting is performed.
48.	Noise	6	6	6	216	High	Identify and formally demarcate noise zones. Enforce and monitor use of HPD's. Investigate engineering changes to noise sources. The use of mobile screens should be investigated.
49.	Thermal Stress (heat)	8	3	0.5	1.8	Tolerable	Provide training to employees and provide proper warm clothing for surfacing employees.
50.	Thermal Stress (cold)	6	2	6	72	Medium	
51.	Non Ionising Radiation	2	3	0.1	0.6	Tolerable	Ensure compliance to the wearing of PPE. Risk rating is based on PPE use.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

HEALTH HAZARD	CONSEQUENCES (C)	EXPOSURE (E)	PROBABILITY OF EXCEEDING THE OEL (P)	RISK (C×E×P)	RISK CLASSIFICATION	ACTION
HEG DC.18 – TYRE TECHNICIAN						
52. Vulcanising solution as trichloroethylene	6	2	0.1	1.2	Tolerable	Only apply the chemical in adequately ventilated areas. The risk rating is based on the current short and intermittent application protocol.
53. Noise	6	3	6	108	Medium	Identify and formally demarcate noise zones. Enforce and monitor use of HPD's. Investigate engineering changes to noise sources. The use of mobile screens should be investigated.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

8 CURRENT CONTROL MEASURES

ELIMINATION, SUBSTITUTION OR CHANGES AT SOURCE			
CONTROL	✓	DESCRIPTION	EFFECTIVENESS
Elimination and / or substitution			
Process changes or modifications			
Reduction of number of HCS			
Changes in the physical form of HCS			
ENGINEERING CONTROL MEASURES			
CONTROL	✓	DESCRIPTION	EFFECTIVENESS
Isolation		Wet methods – watering down procedures	The wet methods are effective in reducing inhalation exposure in slopes and development areas. General mine ventilation is only partially effective in reducing inhalation exposure to gases and DPM. The efficiency of natural ventilation in workshops will depend on the activities inside the workshop i.e. It may not be efficient in reducing concentrations if several vehicles are idled or revved inside the workshop at once. Efficient in reducing emission of DEE.
Total or partial enclosure		General mine ventilation through shafts and surface fans.	
Screening	✓	Force fans for development ends and stopes used in conjunction with ventilation curtains.	
Local extraction ventilation systems		General natural ventilation for workshop areas i.e. the workshops are open and natural air flows through the areas.	
Dilution ventilation systems	✓	Vehicle idling and revving is limited to fault finding and testing periods.	
Wet methods	✓		
ADMINISTRATIVE CONTROL MEASURES			
CONTROL	✓	DESCRIPTION	EFFECTIVENESS
Shift arrangements		Re-entry periods after blasting.	Partially effective since ammonia is still introduced to the fresh air stream via development end material i.e. Ammonia is trapped underneath material during blasting and released during loading. The effectiveness is limited to the current contents of the induction training material. Reduced exposure time is effective in most areas. Controls are in general partially effective in reducing exposure.
Limit number of exposed employees	✓	Information, training and awareness on health risks as per induction programme.	
Limit time spend in area	✓	Only short and intermittent periods of time is spent in underground mine areas during breakdowns and minor services where they will mostly be in well ventilated areas for the majority of the time. The reduced exposure time is thus the determining factor in the lower anticipated exposure concentrations.	
Safe work procedures	✓		
Supervision			
Information, training & awareness	✓	The workshop is informally regarded as a noise zone however the necessary signs were not observed.	
Provision of hygiene facilities	✓		

ABC		OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop				REF # : XXX REV # : 0.0 DATE : 15/03/2006	
Information and/or demarcation signs		✓	Several of the chemicals are used in small quantities and for short periods of time, which reduces the risk of significant exposure. Hand wash facilities are available. The spray application of degreaser is usually limited to one or two engineering aides or assistants.				
MAINTENANCE OF EQUIPMENT							
CONTROL		✓	DESCRIPTION		EFFECTIVENESS		
Regular equipment inspections		✓	Vehicles are currently on a planned maintenance and service system.		The system is only partially effective since no valid info could be obtained of any form of catalytic converter, air filter or wet scrubber system on vehicles to remove DEE. The service and maintenance operations will serve to reduce emissions only to a certain degree.		
Available operating logs							
Regular equipment services		✓					
Planned maintenance		✓					
PERSONAL PROTECTIVE EQUIPMENT (PPE)							
PPE	TYPE	COMPLIANCE	PPE	TYPE	COMPLIANCE		
Hard hat	MSA V-Guard	Good	Respiratory protection	DRO Air 1020FFP2 SL N/N FFP2S Disposable dust mask	Not enforced – below average		
Foot protection	Steel toe cap gumboots	Good	Eye protection	Safety Glasses	Average		
Overalls	1 or 2PCE Blue cotton	Good					
Gloves	Leather	Good					
Hearing protection	Howard Leight DPAS-30R reusable plugs (NRR 27) & Custom Moulded i.e. Variphones	Good					

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

9 GENERAL INFORMATION

SUBJECT		DESCRIPTION	EFFECTIVENESS
MONITORING			
	Occupational Hygiene Monitoring	Hygiene monitoring is limited to spot measurements and not routine monitoring.	Inadequate
	Biological Monitoring	Medical surveillance as part of "red ticket"	Inadequate
	Medical surveillance	The medical surveillance done at the moment is only generic i.e. not risk based.	Partially effective
FIRST AID FACILITIES			
	Access to first-aid box	Available in waiting places and on surface	Good
	Access to a Clinic / First Aide station	On site hospital available to all employees	
WELFARE & PERSONAL HYGIENE			
	Abution facilities	Toilet facilities in an unhygienic condition in underground areas. Not easily accessible in all areas.	Partially effective
	Hand washing & drinking water	Drinking water not always easily accessible and available in underground areas. No soap available underground for washing of hands after contamination with for example oil.	Partially effective
	Waiting area / Green areas / Canteen	Overalls are handed in for washing daily.	Partially effective
	Facilities for washing of PPE	No underground storage of PPE observed.	Poor since employees do not have access to PPE items such as gloves, respirators or HPD's underground.
	Storage facilities for PPE		

10 ADDITIONAL INFORMATION

In general poor compliance was observed to the wearing of any form of respiratory protection.

Spray painting should be regarded as a high risk operation re. exposure to volatile organic compounds.

Cold stress is regarded as a moderate to high risk in most instances, due to the presence of significant air velocities with low temperatures mainly at the shafts and material declines. Actual conditions and exposures (including time and exposure values) should however be quantified/assessed during winter months.

Specific attention should be given to the quantification of Diesel Particulate Matter and vehicle filtering systems.

MSDS system does not contain info on all hazardous chemical substances e.g. process emissions and by products. MSDS's is also not readily available to all employees.

Illumination in general need to be upgraded to comply with recommended minimum levels.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

11 CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS	RECOMMENDATIONS
The following occupational health risks were identified as significant risks: • Paint during spray painting • Noise • Diesel Exhaust Emissions with specific mention to particulate matter (carbon and VOC's) • Thermal stress (extreme cold) Risk ratings are subject to change once identified hazards have been quantified through comprehensive surveys/ monitoring. Pregnant women to be excluded from performing any task that requires the handling of solvents. Training and awareness with regard to occupational hygiene hazards is inadequate. MSDS's of HCS not readily available to all levels of personnel e.g. underground.	• A quantitative hygiene risk assessment needs to be conducted/ future routine monitoring data should be used to confirm allocated risk ratings. • Occupational Hygiene measurements should be upgraded to conform to the guidelines/specifications of the DME. Measurement data should further be linked to individual/occupational medical profiles to assist occupational Medical Personnel with risk based health surveillance and biological monitoring • Implement formal hearing conservation and respiratory protection programmes. • Formally demarcate work places re. hearing and respiratory protection zones and enforce the wearing of PPE i.e. workshops should be demarcated as a noise zone and spray painting and degreaser activities should be regarded as compulsory respirator activities. • Implement training and awareness program with regard to specific applicable occupational hygiene hazards • Ensure the availability and accessibility of MSDS's for chemical substances and process emissions to all employees • Regular Hygiene inspections should be performed on all toilet facilities. • Exposure to hand-arm vibration should be performed by a vibration specialist. • An in depth ergonomic assessment needs to be conducted on high risk occupations re. manual lifting, body postures, vehicle ergonomics, etc. • A comprehensive illumination quantification survey needs to be done in all areas to determine current illumination levels and sub standard conditions.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

12 ACTION PLAN

To eliminate / reduce the occupational health risks identified through this occupational health risk assessment, the following action has been discussed and agreed.

No	Action Required	Responsible person(s)	Completion date
1			
2			
3			
4			
5			
6			
7			
8			
9			

A review date of this occupational health risk assessment was agreed for March 2008.

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop	REF # : XXX REV # : 0.0 DATE : 15/03/2006

13. PERSON-JOB SPECIFICATIONS:

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

14. OCCUPATIONAL HEALTH RISK ASSESSMENT RECORD FOR RISK BASED MEDICAL SURVEILLANCE

OPERATION: ABC Mine

AREA: AREA 1.1 Underground Diesel Workshop

HEG	EXPOSED OCCUPATIONS	IDENTIFIED RISKS	RISK RATING	RECOMMENDED TESTS	TEST INTERVAL
DC15	Underground TM3 Workshop personnel - Diesel Mechanic and Assistant - Auto-electrician and Assistant - Boilermaker and Assistant - Diesel Mechanics (shifts) - Engineering Aides	Noise	A	• Clinical examination	Initial
DC16		Platinum mine dust	D	• Audiogramme	12 months
DC17		CO	D	• CXR	
		CO ₂	D	• Lung function	
		NH ₃	D	• Vision screening	job change
		NO	C	• Urinalysis	work place change
		NO ₂	D	• Questionnaire	
		Oil mist (Drill Operators)	D	• Physical	acute exposure
		Cement dust/SiO ₂ (Rosond Contractors)	D		exit
		Thermal stress – heat	B		
		Thermal stress – cold	C		

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop	REF # : XXX
		REV # : 0.0
		DATE : 15/03/2006

DC18	Surface Engineering Personnel Tyre Technician	Noise	A	- Clinical examination - Audiogramme - CXR - Lung function - Vision screening - Urinalysis - Questionnaire - Physical	Initial 12 months job change work place change acute exposure exit
		Platinum mine dust	D		
		CO	D		
		CO ₂	D		
		NH ₃	D		
		NO	C		
		NO ₂	D		
		Thermal stress – heat	B		
		Thermal stress – cold	C		
		Welding fumes (Boilermakers & aides)	D		

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop		REF # : XXX
			REV # : 0.0
			DATE : 15/03/2006

DC14	Roving Senior Foreman	Noise	B	- Clinical examination - Audiogramme - CXR - Lung function - Vision screening - Urinalysis - Questionnaire - Physical	Initial
		Platinum mine dust	D		24 months
		CO	D		job change
		CO ₂	D		work place change
		NH ₃	D		acute exposure
		NO	C		exit
		NO ₂	D		
		Thermal stress – heat	C		
		Thermal stress – cold	D		

Signed by:

Occupational Hygienist

Occupational Medical Practitioner

PERSON-JOB SPECIFICATION

OCCUPATION GROUP: AREA 1.1 DECLINES UNDERGROUND		Activity area: Declines Eng. Workshops		Mine: ABC Mine		Date: 3/4/2006	
REG DC.14 - FOREMAN AND MAINTENANCE MANAGER		Surface, non-risk (S)		Underground (U)		x	
Special category:		Surface, risk (SR)		Other		Hot	
						Cool	
FUNCTIONAL REQUIREMENTS (Level of priority: 3 - High; 2 - Medium; 1 - Low; 0 - No priority)							
HAZARD EXPOSURE (Risk rating: AA - Very high; A - High; B - Medium; C - Low; D - Tolerable)							
CHEMICALS Cat's: I = Irritant; A = Asphyxiant; S = Sensitiser AN = Anesthetic/narcotic; Sys = Systemic poison CMT = Carcinogen/mutagen/teratogen; D = Dermatitits							
AREA		PHYSICAL		CHEMICAL		BIOLOGICAL	
Underground		Noise (≤ 85 dB(A))		Platinum Mine Dust		Viruses	
Boxholes	Climbing by means of chain ladder	0	Noise (≥ 105 dB(A))		Asbes		Man Made Mineral Fibres
Stopes	Climbing by means of a climbing chain	0	Heat		Fungi		Silica/quarts
Haulages	Crawling/stoop walking	0	Cold		Parasites		Animal protein
Stairs	Climbing over environmental obstacles	0	Glare		Bacteria		Grain/Cotton/Flax
	Walking on uneven surfaces	1	Vibration (hand-arm)		Other		Other
	Climbing ability and endurance	1	Vibration (whole body)				
	Surface		Radiation (ionising)				
	Mobility in restricted areas; stoop walking, crawling	0	Other				
	Climbing over environmental obstacles	0					
	Walking	1					
	Climbing ability and endurance	1					
WORK TASKS		ERGONOMICS		CHEMICAL		BIOLOGICAL	
Upper limb function and endurance		0	Prolonged sitting		Viruses		DUST
Frequent lifting capacity		0	Prolonged bending		Fungi		Asbes
Floor to knee level		0	Prolonged standing		Parasites		Man Made Mineral Fibres
Knee level to above head level		0	Shift work		Bacteria		Silica/quarts
Lifting of loads to 25 kg		0	Poor illumination		Other		Animal protein
Floor to knee level		0	Uneven terrain				Grain/Cotton/Flax
Knee level to shoulder level		0	Handling of loads				Other
Upper limb & lower limb strength & endurance		0	Stress & frustration				
Lashing		0	Hard Hat				
Pack building		0	Eye Protection				
Work with a hammer		0	Face Shield				
Functional grip strength		0	Hearing Protection				
Outer range reaching ability		0	Particulate mask				
Upper limb endurance		0					
Dexterity (fine coordinated movements with hands)		0					
Working with a spanner to loosen & fasten nuts & bolts		0					
Squat/kneeling		0					
Lower limb flexibility & weight bearing ability		0					
Sloop		0					
Work above head		0					
Standing on a ladder scaffold		0					
Balance & equilibrium		0					
IMPORTANT SENSES & OTHER REQUIREMENTS		PPE REQUIRED		MEDICAL EXAMINATIONS (months)*		ADDITIONAL NOTES	
Hearing			Respirator		1 OH Pyrene (Urine)		ECG
Vision			Eye Protection		Phenol (Urine)		Unanalysis
Colour			Face Shield		CO (exhaled air)		Blood-lead
Night			Hearing Protection		Mn		Questionnaire
Depth			Particulate mask		Vision screening		Physical
Clarity of speech							
Ability to read							
Ability to write							
EXCLUSIONS		APPROVAL		SIGNATURE			
Respiratory impairment		Name		Designation		Date	
Pregnant employee							
Breastfeeding employee							
Pacemaker							
Steel implants							
Spectacles							
Epilepsy							
Fear of heights							
Infectious disease							

* 1 - INITIAL; 2 - PERIODICAL (6 MONTHS); 3 - PERIODICAL (12 MONTHS); 4 - PERIODICAL (24 MONTHS); 5 - (36 MONTHS); 6 - JOB OR WORKPLACE CHANGE; 7 - ACCUTE EXPOSURE; 8 - EXIT

PERSON-JOB SPECIFICATION

OCCUPATION GROUP: AREA 1.1 - DECLINES UNDERGROUND				Activity area: Declines Eng. Workshops		Mine: ABC		Date: 3/4/2008	
HEG DC.15 - DIESEL MECHANIC, ASSISTANT AND AIDE				Surface, non-risk (S)		Underground (U)		Hot	
Special category:				Surface, risk (SR)		Other		Cool	
FUNCTIONAL REQUIREMENTS (Level of priority: 3 - High; 2 - Medium; 1 - Low; 0 - No priority)				OREP		HAZARD EXPOSURE (Risk rating: AA - Very high; A - High; B - Medium; C - Low; D - Tolerable)			
AREA				PHYSICAL		CHEMICALS			
Underground				Noise (≥ 85 dB(A))		Cat's: I = Irritant; A = Asphyxiant; S = Sensitizer; Cor = Corrosive			
Boxholes	Climbing by means of chain ladder	0			A				
Stopes	Climbing by means of a climbing chain	0			C				
	Crawling/sloot walking	0			A				
	Climbing over environmental obstacles	0			C				
Haulages	Walking on uneven surfaces	1			C				
Stairs	Climbing ability and endurance	1			C				
	Surface								
Restricted work environment	Mobility in restricted areas; stoop walking, crawling	0							
	Climbing over environmental obstacles	0							
Unrestricted work environment	Walking	1							
Stairs	Climbing ability and endurance	1			C				
	WORK TASKS								
Making safe: baring	Upper limb function and endurance	0							
Handling of loads: lifting	Frequent lifting capacity								
	Floor to knee level	1							
	Knee level to above head level	0							
	Lifting of loads to 25 kg								
	Floor to knee level	1							
	Knee level to shoulder level	0							
Handling of loads: push/pull	Upper limb & lower limb strength & endurance	1							
	Upper limb function and endurance								
Lashing	Upper limb function and endurance	0							
Pack building	Handling loads in restricted work areas								
Work with a hammer	Handling impacts on the upper limbs	2							
	Functional grip strength	2							
	Outer range reaching ability	2							
	Upper limb endurance	2							
Working with a spanner to loosen & fasten nuts & bolts	Dexterity (fine coordinated movements with hands)	3							
	WORK POSITION								
Squat/kneeling	Lower limb flexibility & weight bearing ability	2							
Stoop	Back flexibility, strength & endurance	2							
Work above head	Outer range reaching & upper limb endurance	2							
Standing on a ladder/scaffold	Balance & equilibrium	2							
	IMPORTANT SENSES & OTHER REQUIREMENTS								
Hearing		3							
Vision	Eye sight	3							
	Colour	3							
	Night	3							
	Depth	3							
Other	Clarity of speech	3							
	Ability to read	3							
	Ability to write	3							
				EXCLUSIONS					
	Respiratory impairment				x				
	Pregnant employee				x				
	Breastfeeding employee				x				
				APPROVAL					
	Name				Designation			Date	Signature
				PPE REQUIRED					
	Hard Hat				Yes				
	Eye Protection				Yes				
	Face Shield				Yes				
	Hearing Protection				Yes				
	Particulate mask				Yes				
				# MEDICAL EXAMINATIONS (months)*					
	Clinical examination				1:3:6:8				
	1 OH Pyrene (Urine)				1:3:6:8				
	Phenol (Urine)				1:3:6:8				
	CO (exhaled air)				1:3:6:8				
	Mn				1:3:6:8				
	Vision screening				1:3:6:8				
				ADDITIONAL NOTES					
				EXCLUSIONS					
	Respiratory impairment				x				
	Pacemaker				x				
	Steel implants				x				
	Spectacles				x				
				APPROVAL					
	Name				Designation			Date	Signature

* 1 - INITIAL; 2 - PERIODICAL (6 MONTHS); 3 - PERIODICAL (12 MONTHS); 4 - PERIODICAL (24 MONTHS); 5 - (36 MONTHS); 6 - JOB OR WORKPLACE CHANGE; 7 - ACCUTE EXPOSURE; 8 - EXIT

PERSON~JOB SPECIFICATION

OCCUPATION GROUP: AREA 1.1 DECLINES UNDERGROUND			Activity area: Declines Eng. Workshops		Mine: ABC Mine		Date: 3/4/2006	
HEG DC-16- AUTO ELECTRICIAN, ASSISTANT AND AIDE			Surface, non-risk (S)		Underground (U)		Hot	
Special category:			Surface, risk (SR)		Other		Cool	
FUNCTIONAL REQUIREMENTS (Level of priority: 3 - High; 2 - Medium; 1 - Low; 0 - No priority)			OREP		HAZARD EXPOSURE (Risk rating: AA - Very high; A - High; B - Medium; C - Low; D - Tolerable)			
AREA			PHYSICAL		CHEMICALS			
Underground			Noise (≥ 85 dB(A))		Cat's: I = Irritant; A = Asphyxiant; S = Sensitiser; Cor = Corrosive			
Boxholes	Climbing by means of chain ladder	0	Noise (≥ 105 dB(A))		AN = Anesthetic/narcotic; Sys = Systemic poison			
Slopes	Climbing by means of a climbing chain	0	Heat		CMT = Carcinogen/mutagen/teratogen; D = Dermatitis			
Slopes	Crawling/stoop walking	0	Cold		Chemical			
Slopes	Climbing over environmental obstacles	0	Glare		Risk			
Haulages	Walking on uneven surfaces	1	Vibration (hand-arm)		Target organ			
Stairs	Walking on uneven surfaces	1	Vibration (whole body)		BM?			
Stairs	Climbing ability and endurance	1	Radiation (ionising)					
Stairs	Climbing ability and endurance	1	Other					
Restricted work environment	Mobility in restricted areas; stoop walking, crawling	0	Heights					
Unrestricted work environment	Climbing over environmental obstacles	0	Confined spaces					
Stairs	Walking	1	Abnormal posture					
Stairs	Climbing ability and endurance	1	Repetitive movements					
WORK TASKS			Prolonged sitting					
Making safe: baring			Prolonged bending					
Handling of loads: lifting			Prolonged standing		DUST			
			Shift work		Asbes			
			Poor illumination		Man Made Mineral Fibres			
			Uneven terrain		Silica/quarts			
			Handling of loads		Parasites			
			Stress & frustration		Bacteria			
					Animal protein			
					Grain/Cotton/Flax			
					Other			
Handling of loads: push/pull			C					
Lashing			Yes		Respirator			
Pack building			Yes		Safety socks			
Work with a hammer			Yes		Safety shoes			
			Yes		Gum boots			
			Yes		Other			
			Yes		Yes			
Working with a spanner to loosen & fasten nuts & bolts			1		# MEDICAL EXAMINATIONS (months)*			
			3		1 OH Pyrene (Urine)			
					1 OH Pyrene (Urine)			
					Phenol (Urine)			
					CO (exhaled air)			
					Mn			
					Vision screening			
					1:3:6:8			
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1 - INITIAL; 2 - PERIODICAL (6 MONTHS); 3 - PERIODICAL (12 MONTHS); 4 - PERIODICAL (24 MONTHS); 5 - (36 MONTHS); 6 - JOB OR WORKPLACE CHANGE; 7 - ACUTE EXPOSURE; 8 - EXIT

PERSON-JOB SPECIFICATION

OCCUPATION GROUP: AREA 1.1 DECLINES UNDERGROUND			Activity area: Declines Eng. Workshops		Mine: ABC Mine		Date: 3/4/2008	
HEG DC.17 - BOILERMAKER, ASSISTANT AND AIDE			Surface, non-risk (S)		Underground (U)		Hot	
Special category:			Surface, risk (SR)		Other		Cool	
FUNCTIONAL REQUIREMENTS (Level of priority: 3 - High; 2 - Medium; 1 - Low; 0 - No priority)			OREP		(Risk rating: AA - Very high; A - High; B - Medium; C - Low; D - Tolerable)			
AREA			PHYSICAL		HAZARD EXPOSURE			
					Chemical	Cat	Risk	Target organ
					Platinum Mine Dust	Sys	C	Lungs
					Ammonia gas	I	C	Lungs
					Diesel Particulate Matter	Sys	C	Lungs
					Carbon Monoxide gas	Sys	C	Lungs
					Carbon Dioxide gas	A	C	Lungs
					Nitrogen Dioxide gas	A	C	Lungs
					Nitrous Fumes	Sys	C	Lungs
					Welding Fume Fe & Mn.	Sys	C	Lungs
					Repetitive movements			
					Abnormal posture			
					Prolonged sitting			
					Prolonged bending			
					Prolonged standing			
					Shift work			
					Poor illumination			
					Uneven terrain			
					Handling of loads			
					Stress & frustration			
					Hard Hat			
					Eye Protection			
					Face Shield			
					Hearing Protection			
					Particulate mask			
					Clinical examination			
					Dexterity (fine coordinated movements with hands)			
					Lower limb flexibility & weight bearing ability			
					Back flexibility, strength & endurance			
					Outer range reaching & upper limb endurance			
					Balance & equilibrium			
					Upper limb function and endurance			
					Handling loads in restricted work areas			
					Functional grip strength			
					Outer range reaching ability			
					Upper limb endurance			
					Dexterity (fine coordinated movements with hands)			
					Working with a spanner to loosen & fasten nuts & bolts			
					Squat/kneeling			
					Stoop			
					Work above head			
					Standing on a ladder/scaffold			
					Hearing			
					Vision			
					Eye sight			
					Colour			
					Night			
					Depth			
					Clarity of speech			
					Ability to read			
					Ability to write			
					Upper limb function and endurance			
					Frequency lifting capacity			
					Floor to knee level			
					Knee level to above head level			
					Lifting of loads to 25 kg			
					Floor to knees level			
					Knuckle level to shoulder level			
					Upper limb & lower limb strength & endurance			
					Upper limb function and endurance			
					Handling loads in restricted work areas			
					Functional grip strength			
					Outer range reaching ability			
					Upper limb endurance			
					Dexterity (fine coordinated movements with hands)			
					Working with a spanner to loosen & fasten nuts & bolts			
					Squat/kneeling			
					Stoop			
					Work above head			
					Standing on a ladder/scaffold			
					Hearing			
					Vision			
					Eye sight			
					Colour			
					Night			
					Depth			
					Clarity of speech			
					Ability to read			
					Ability to write			
					Upper limb function and endurance			
					Frequency lifting capacity			
					Floor to knee level			
					Knee level to above head level			
					Lifting of loads to 25 kg			
					Floor to knees level			
					Knuckle level to shoulder level			
					Upper limb & lower limb strength & endurance			
					Upper limb function and endurance			
					Handling loads in restricted work areas			
					Functional grip strength			
					Outer range reaching ability			
					Upper limb endurance			
					Dexterity (fine coordinated movements with hands)			
					Working with a spanner to loosen & fasten nuts & bolts			
					Squat/kneeling			
					Stoop			
					Work above head			
					Standing on a ladder/scaffold			
					Hearing			
					Vision			
					Eye sight			
					Colour			
					Night			
					Depth			
					Clarity of speech			
					Ability to read			
					Ability to write			
					Upper limb function and endurance			
					Frequency lifting capacity			
					Floor to knee level			
					Knee level to above head level			
					Lifting of loads to 25 kg			
					Floor to knees level			
					Knuckle level to shoulder level			
					Upper limb & lower limb strength & endurance			
					Upper limb function and endurance			
					Handling loads in restricted work areas			
					Functional grip strength			
					Outer range reaching ability			
					Upper limb endurance			
					Dexterity (fine coordinated movements with hands)			
					Working with a spanner to loosen & fasten nuts & bolts			
					Squat/kneeling			
					Stoop			
					Work above head			
					Standing on a ladder/scaffold			
					Hearing			
					Vision			
					Eye sight			
					Colour			
					Night			
					Depth			
					Clarity of speech			
					Ability to read			
					Ability to write			
					Upper limb function and endurance			
					Frequency lifting capacity			
					Floor to knee level			
					Knee level to above head level			
					Lifting of loads to 25 kg			
					Floor to knees level			
					Knuckle level to shoulder level			
					Upper limb & lower limb strength & endurance			
					Upper limb function and endurance			
					Handling loads in restricted work areas			
					Functional grip strength			
					Outer range reaching ability			
					Upper limb endurance			
					Dexterity (fine coordinated movements with hands)			
					Working with a spanner to loosen & fasten nuts & bolts			
					Squat/kneeling			
					Stoop			
					Work above head			
					Standing on a ladder/scaffold			
					Hearing			
					Vision			
					Eye sight			
					Colour			
					Night			
					Depth			
					Clarity of speech			
					Ability to read			
					Ability to write			
					Upper limb function and endurance			
					Frequency lifting capacity			
					Floor to knee level			
					Knee level to above head level			
					Lifting of loads to 25 kg			
					Floor to knees level			
					Knuckle level to shoulder level			
					Upper limb & lower limb strength & endurance			
					Upper limb function and endurance			
					Handling loads in restricted work areas			
					Functional grip strength			
					Outer range reaching ability			
					Upper limb endurance			
					Dexterity (fine coordinated movements with hands)			
					Working with a spanner to loosen & fasten nuts & bolts			
					Squat/kneeling			
					Stoop			
					Work above head			
					Standing on a ladder/scaffold			
					Hearing			
					Vision			
					Eye sight			
					Colour			
					Night			
					Depth			
					Clarity of speech			
					Ability to read			
					Ability to write			
					Upper limb function and endurance			
					Frequency lifting capacity			
					Floor to knee level			
					Knee level to above head level			
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					Upper limb & lower limb strength & endurance			
					Upper limb function and endurance			
					Handling loads in restricted work areas			
					Functional grip strength			
					Outer range reaching ability			
					Upper limb endurance			
					Dexterity (fine coordinated movements with hands)			
					Working with a spanner to loosen & fasten nuts & bolts			
					Squat/kneeling			
					Stoop			
					Work above head			
					Standing on a ladder/scaffold			
					Hearing			
					Vision			
					Eye sight			
					Colour			
					Night			
					Depth			
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					Ability to read			
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					Upper limb function and endurance			
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					Knuckle level to shoulder level			
					Upper limb & lower limb strength & endurance			
					Upper limb function and endurance			
					Handling loads in restricted work areas			
					Functional grip strength			
					Outer range reaching ability			
					Upper limb endurance			
					Dexterity (fine coordinated movements with hands)			
					Working with a spanner to loosen & fasten nuts & bolts			
					Squat/kneeling			
					Stoop			
					Work above head			
					Standing on a ladder/scaffold			
					Hearing			
					Vision			
					Eye sight			
					Colour			
					Night			
					Depth			
					Clarity of speech			
					Ability to read			
					Ability to write			

OCCUPATION GROUP: AREA 1.1 DECLINES UNDERGROUND						Activity area: Declines Eng. Workshops		Mine: ABC Mine		Date: 3/4/2006
HEG DC-18 - TYRE TECHNICIAN		OREP	Surface, non-risk (S)	Surface, risk (SR)	x	Other	Hot	Cool		
Special category:										
FUNCTIONAL REQUIREMENTS (Level of priority: 3 - High; 2 - Medium; 1 - Low; 0 - No priority)										
AREA										
Underground										
Boxholes	Climbing by means of chain ladder	0	Noise (≥ 85 dB(A))	A						
Stopes	Climbing by means of a climbing chain	0	Noise (≥ 105 dB(A))							
Haulages	Crawling/stoop walking	0	Heat							
Stairs	Climbing over environmental obstacles	0	Cold							
	Walking on uneven surfaces	0	Glare							
	Climbing ability and endurance	0	Vibration (hand-arm)							
	Surface		Vibration (whole body)							
Restricted work environment	Mobility in restricted areas; stoop walking, crawling	0	Radiation (ionising)							
Unrestricted work environment	Climbing over environmental obstacles	0	Radiation (Non-ionising)							
Stairs	Walking	1	Heights							
	Climbing ability and endurance	1	Confined spaces							
	WORK TASKS		Abnormal posture							
Making safe: barring	Upper limb function and endurance	0	Repetitive movements							
Handling of loads: lifting	Frequent lifting capacity		Prolonged sitting							
	Floor to knee level	1	Prolonged bending							
	Knee level to above head level	0	Prolonged standing							
	Lifting of loads to 25 kg		Shift work							
	Floor to knee level	1	Poor illumination							
	Knee level to shoulder level	0	Uneven terrain							
Handling of loads: push/pull	Upper limb & lower limb strength & endurance	2	Handling of loads	C						
	Upper limb function and endurance	0	Stress & frustration							
Lashing	Upper limb function and endurance	0	Hard Hat	Yes						
Pack building	Handling loads in restricted work areas	0	Eye Protection	Yes						
Work with a hammer	Handling impacts on the upper limbs	1	Face Shield							
	Functional grip strength	1	Hearing Protection	Yes						
	Outer range reaching ability	1	Particulate mask	Yes						
	Upper limb endurance	1	Gloves	Yes						
Working with a spanner to loosen & fasten nuts & bolts	Dexterity (fine coordinated movements with hands)	1	Clinical examination	1:3:6:8						
	WORK POSITION		1 OH Pyrene (Urine)							
Squat/kneeling	Lower limb flexibility & weight bearing ability	1	Audiogrammes	1:3:6:8						
Stoop	Back flexibility, straightness & endurance	1	CXR	1:3:6:8						
Work above head	Outer range reaching & upper limb endurance	0	Lung function	1:3:6:8						
Standing on a ladder scaffold	Balance & equilibrium	0	Vision screening	1:3:6:8						
IMPORTANT SENSES & OTHER REQUIREMENTS										
Hearing	Eye sight	3	Respiratory impairment	x						
Vision	Colour	3	Pregnant employee	x						
	Night	1	Breastfeeding employee	x						
	Depth	1	Name							
	Clarity of speech	3	Designation							
Other	Ability to read	1	Date							
	Ability to write	1	Signature							

1 - INITIAL; 2 - PERIODICAL (6 MONTHS); 3 - PERIODICAL (12 MONTHS); 4 - PERIODICAL (24 MONTHS); 5 - (36 MONTHS); 6 - JOB OR WORKPLACE CHANGE; 7 - ACUTE EXPOSURE; 8 - EXIT

Occupational health risk matrix

CONSEQUENCE OF EXPOSURE	Risk Factor
Catastrophic (many mortalities or damages over R 10 000 000,00)	100
Disaster (a few mortalities or damages over R 5 000 000,00)	40
Very serious (one mortality or damages over R 1 000 000,00)	15
Serious (many permanent illnesses or damages over R 500 000,00)	7
Serious (few permanent illnesses or damages over R 100 000,00)	6
Serious (one permanent illnesses or damages over R 20 000,00)	5
Important (many temporary illnesses or damages over R 10 000,00)	4
Important (few temporary illnesses or damages over R 5 000,00)	3
Important (one temporary illness or damages over R 2 000,00)	2
Of concern (many minor illnesses or damages over R 1 000,00)	1
Of concern (few minor illnesses or damages over R 500,00)	0.5
Of concern (one minor illness or damage over R 200,00)	0.1

EXPOSURE	Risk Factor
Continuous for 8 hour shift (Continuous)	10
Continuous for between 2 and 4 hours (Frequent, daily)	6
Continuous for between 1 and 2 hours (Often, weekly)	3
Short periods of time, a few times per day (Unusual, monthly)	2
Very unusual, a few times per week (a few times per year)	1
Rare, a few times per month (yearly)	0.5
Exceptionally exposed, a few times per year (Exceptional)	0.1

PROBABILITY OF EXCEEDING OEL	Risk Factor
Exceeding OEL-C or OEL more than four fold (Might well be expected, happens often)	10
Exceeding OEL-STEL or TWA more than three fold (Quite possible)	6
Exceeding OEL-TWA (Unusual, but possible)	3
Exceeding action limit (50% of OEL-TWA)(Only remotely possible has happened somewhere)	1
Exceeding 25% of the OEL-TWA (Conceivable, has not happened yet)	0.5
Exceeding 10% of the OEL-TWA (one in a million)	0.2
Virtually impossible (approaches the impossible)	0.1

Risk ranking calculation

Consequence x Exposure x Probability

Above 400	AA	VERY HIGH
200 to 399	A	HIGH
70 to 199	B	MEDIUM
20 to 69	C	LOW
Under 20	D	TOLERABLE

ABC	OCCUPATIONAL HEALTH RISK ASSESSMENT Area 1.1 – Underground Diesel Workshop	REF # : XXX
		REV # : 0.0
		DATE : 15/03/2006

15. RISK MATRIX