

## **REVIEW OF BEST PRACTICES REGARDING THE USE OF REFUGE CHAMBERS IN SOUTH AFRICA**

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**F.J. van Zyl  
Senior Engineer  
Bluhm Burton Engineering**

**W. Marx  
Director  
Bluhm Burton Engineering**

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## List of Abbreviations

CoP	Code of Practice
DME	Department of Minerals and Energy
HIRA	Hazard Identification and Risk Assessment
OEM	Original Equipment Manufacturer
OHS	Occupational Health and Safety
ILO	International Labour Organization
MHSA	Mine Health and Safety Act
MHSI	Mine Health and Safety Inspectorate
MOHAC	Mine Occupational Health Advisory Committee
MQA	Mine Qualifications Authority
MRAC	Mine Research Advisory Committee
NIOSH	National Institute for Occupational Safety and Health
ppm	parts per million
RH	Relative Humidity
SABS	South African Bureau of Standards
SAQA	South African Qualifications Authority
SETA	Sector Education and Training Authority
SGB	Standards Generating Body
SIMRAC	Safety in Mines Advisory Committee

# 1 BACKGROUND TO STUDY

BBE has been approached by the National Institute for Safety and Health [NIOSH] in the United States of America to conduct a review on the best practises regarding the use of refuge chambers in South African coal mines.

The purpose of this research effort by NIOSH is to continue to understand the issues associated with the use of refuge chambers and/or safe havens in underground coal mining operations as part of the mine escape and rescue strategies. This will assist in the development of effective mine disaster plans. Part of this understanding is to gain knowledge of refuge chamber use in other countries. This research effort will provide specific information on the characteristics of the design and use of refuge chambers and safe havens currently being used in underground coal mines in South Africa. This will include a review of regulations, risk assessment, emergency preparedness and response, performance testing of refuge chambers, and identification of chamber manufacturers.

## 2 BACKGROUND

The use of rescue chambers is widely practised in South African underground coal mines with both fixed and portable types of rescue chambers currently being used. The successful implementation of underground rescue chambers is dependant on various issues. Some of these are:

- The location or deployment of rescue chambers relative to the underground workforce. Factors that needs to be considered is how to safely get miners from their various places of work into and out of the rescue chambers during emergencies assuming an irrespirable atmosphere.
- The construction and maintenance requirements of rescue chambers to remain operational during underground emergencies such as the aftermath of underground methane and coal dust explosions and fires. Also of importance is the ingress and egress from the rescue chamber in situations of irrespirable outside atmospheres. Equally important is how these requirements are assessed.
- The minimum equipment and amenities required to sustain the life and morale of the miners located in the rescue chamber, e.g. air supply, water, food, communications, toilet facilities, physical environment, safety equipment, first aid, etc.
- Emergency preparedness training and frequency of exercises required to ensure that miners will be able to locate refuge chambers with provided systems in an irrespirable and zero visibility environment and to communicate effectively with rescue coordinators and personnel once secured in a rescue chamber.
- And lastly, what is the rescue strategy and stay period required to bring the miners to safety.

### **3 SCOPE OF WORK**

The scope of work for this review is the use of rescue chambers in underground South African coal mines, with specific reference to the issues raised above as follows:

- Review the regulatory guidelines regarding the use and minimum requirements of rescue chambers;
- Evaluation of the implementation of the regulatory guidelines at major and minor underground coal mining operators, with specific reference to the Hazard Identification and Risk Assessment developed Codes of Practises [CoPs] for Emergency Preparedness and Response;
- Assessment of practical implementation of Emergency Preparedness and Response CoP, with specific focus on rescue chambers at major and minor mining operators [planning, procurement, implementation, and maintenance];
- Review of standards and best practises related to performance testing of all types of rescue chambers; and
- Identification of Original Equipment Manufactures [OEMs] of rescue chambers and associated equipment [Including overview of specific designs].

### **4 REGULATORY REVIEW**

#### **4.1 Regulatory Environment**

The requirement for the use of underground refuge chambers in South African colliers is governed by law, namely the Mine Health and Safety Act of 1996 (Act No. 29 of 1996) [MHSA].

#### **4.2 Origins of the Mine Health and Safety Act**

The MHSA came into effect on 15 January 1997. It replaced the Minerals Act, 50 of 1991 as the legal basis for the regulation of occupational health and safety for the South African Mining Industry. The MHSA flows from an extensive policy review which originated from the Commission of Inquiry into Health and Safety in Mines [“the Leon Commission”] which held hearings in 1994 and published a report and recommendations in April 1995.

One of the four major issues identified by the Leon Commission, which required immediate investigation, was that of disasters from explosions of gas and coal dust in coal mines. This report recommended that legislation pertaining to emergency preparedness and response be developed as a matter of urgency.

From the findings of the Leon Commission the MHSA was developed following extensive tripartite consultations involving representatives from the Department of Minerals and Energy [DME], employers and trade unions in the mining industry. The Parliamentary Portfolio Committee on Minerals and Energy conducted extensive hearings on this subject which resulted in legislation which enjoys a high level of acceptance among employers and employees.

The MSHA replaced the prescriptive based Minerals Act with one that compares favorably with international standards and contemporary legislative trends. It draws extensively on the International Labor Organization [ILO] Mine Safety and Health convention 177 of 1995, which recommends a risk based approach. Certain prescriptive regulations from under the previous Minerals Act were kept in place under Schedule 4 of the MSHA [See Appendix A]. These regulations are being revised and this report will make reference to the relevant current legislation as well as new legislation being developed.

### 4.3 Framework for Acts in South Africa

All acts in South Africa, including the MSHA, are governed by the Constitution Act 108 of 1996. The Constitution under section 24 states that “Everyone has the right to an environment that is not harmful to their health or well being and to have the environment protected through reasonable legislative measures” [Refer to Figure 4.1].

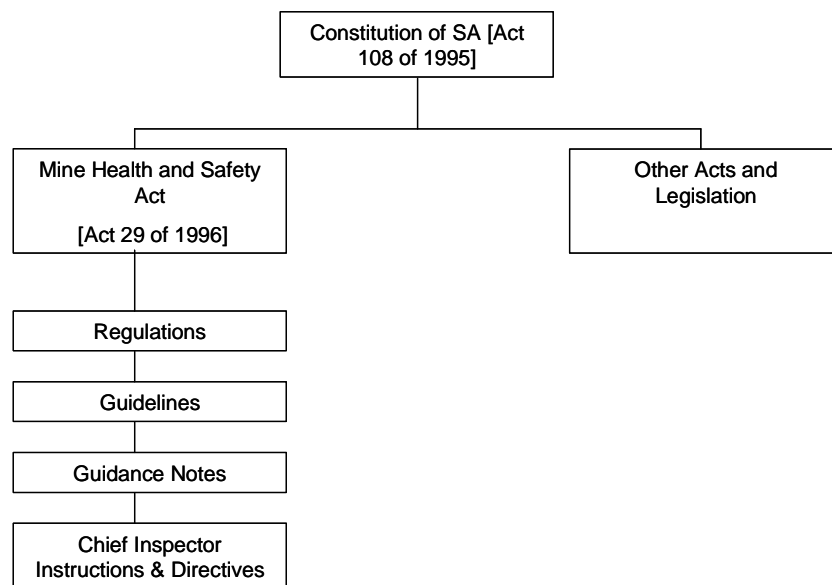


Figure 4.1 Frameworks for Acts in South Africa

The MSHA falls under the jurisdiction of the Minister of Minerals and Energy. The Minister heads up the DME which has a mandate to provide effectual governance of the minerals and energy industries in South Africa to ensure economic growth and development. One of the objectives of the DME are to ensure that these industries are safe and maintain healthy working environments. The Mine Health and Safety Inspectorate [MHSI], as a department within the DME, executes this function on behalf of the DME [Refer to Figure 4.2]. The MHSI is headed by the Chief Inspector of Mines.

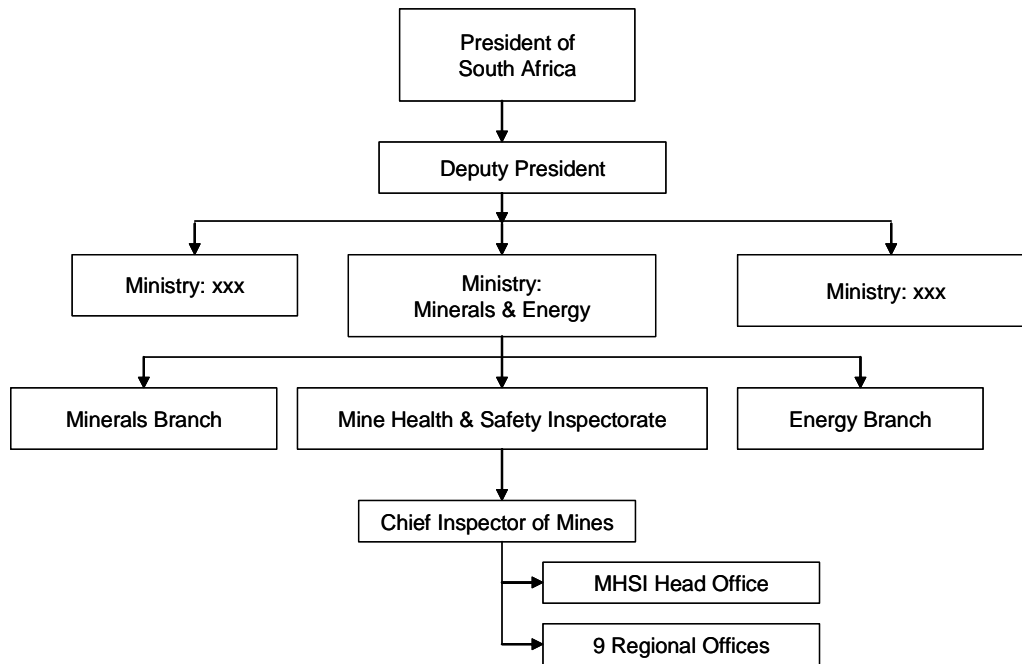


Figure 4.2 Implementation of Acts in South Africa

One of the primary functions of the MHSI is to enforce compliance with the MHSAs. Other functions include inspection of mines, investigations and conducting of inquiries into accidents and other health and safety incidents. The MHSI's enforcement powers include the issuing of compliance or closure notices, the imposition of administrative penalties and the recommendation for prosecutions.

#### 4.4 Framework to Amend [Improve] the MHSAs

To amend the MHSAs the Minister of Minerals and Energy and the Mine Health and Safety Council [MHSC] needs to agree on proposed amendments. The MHSC's function in terms of the MHSAs is to advise the Minister on Occupational Health and Safety legislation and research outcomes focused on ameliorating and promoting occupational health and safety at South African mines. The Council as well as its three statutory tripartite permanent committees consists of 15 non-executive members representing the State, Employers and Employees under chairmanship of a state member. The Permanent Committees were established in terms of Section 41[2] [Appendix B] of the MHSAs and comprises the following:

- The Mining Regulation Advisory Committee [MRAC] is responsible for advising the Council on proposed changes to legislation, guidelines for codes of practice and for standards approved by the South African Bureau of Standards [SABS];
- The Mining Occupational Health Advisory Committee [MOHAC] is responsible for advising the Council on health policies, regulations, research, the management of health risks and data management; and
- The Safety in Mines Research Advisory Committee [SIMRAC] reviews occupational health and safety risks and solicits research projects, manages the conclusion of those projects and advises on the technology transfer of its results.



The organogram depicting the interaction between the various committees, the Council and the Minister is shown on Figure 4.3.

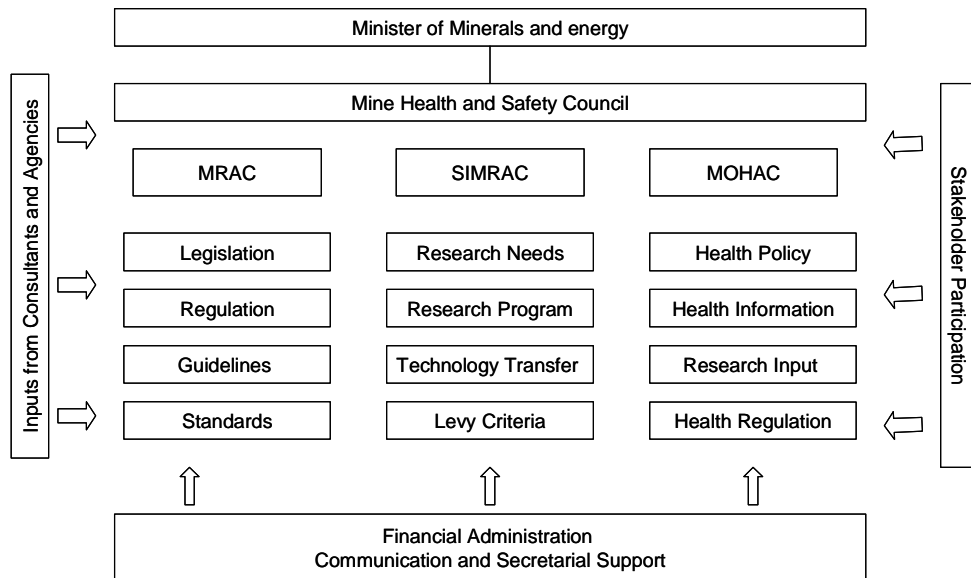


Figure 4.3 Organogram depicting interaction between committees, MHSC and the Minister

## 4.5 Regulatory Mechanisms

To empower the Minister of Minerals and Energy to fulfill one of the objectives of the DME [safe and healthy working environments in mines], the MSHA allows the minister to develop a regulatory framework. The principal elements of the regulatory framework are:

- Regulations;
- Guidelines for Mandatory Codes of Practice [CoPs];
- Chief Inspectors Instructions or Directives; and
- Guidance Notes.

Often the proper regulation of a topic would require making use of more than one of these regulatory mechanisms. The principle regulatory mechanisms are discussed in the following sections.

### 4.5.1 Regulations

Regulations are drafted where an issue is common to all mines and can be complied with. Regulations must be drafted in such a nature that mines would not need to apply for exemption from these regulations. Furthermore, regulations are to be outcomes based and hence should not prescribe to the employer on how to address a significant risk, identified in terms of the hazard identification and risk assessment [HIRA] process, but should allow the employer to implement a hierarchy of control measures to reduce or eliminate the risk.

### 4.5.2 Guidelines for Mandatory Codes of Practice

Guidelines are drafted where site specific flexibility is required as a result of varying conditions existing at the different mines.

### 4.5.3 Chief Inspectors Instructions and Directives

Directives or instructions are issued by the Chief Inspector of Mines on any health and safety matter that requires attention or to distribute information relating to health and safety at mines.

#### **4.5.4 Guidance Notes**

A guidance note sets out good practice.

### **4.6 Responsibilities for Ensuring Compliance with Legislation**

#### **4.6.1 Role of the Inspectorate**

The MHSIs head office is responsible for the development of policy and legislation and it produces guidelines for Codes of Practice, and other guidance documents for the mining industry.

The primary functions of the Regional MHSI are to inspect mines, to investigate and conduct inquiries into accidents and other health and safety incidents and to enforce compliance with the MHSA.

#### **4.6.2 Role of Employers**

In terms of this legislation the employer is ultimately responsible for the health and safety of employees and this is inclusive of:

- A safe place of work;
- A safe system of work;
- A competent and properly trained staff and supervisors; and
- Fit for purpose plant and equipment.

The employer is required to adopt a systematic approach to identify hazards, assess the health and safety risks to which employees may be exposed while they are at work, and record the significant hazards identified and risk assessed. The employer must determine how the significant risks identified in the risk assessment process must be dealt with, having regard to the requirement of section 11[2] and [3] of the MHSA in that, as far as reasonably practicable, attempts should first be made to eliminate the risk, thereafter to control the risk at source, thereafter to minimize the risk and thereafter, insofar as the risk remains, to provide personal protective equipment and to institute a programme to monitor the risk.

#### **4.6.3 Role of Employees**

As far as employees are concerned, Section 22 of the MHSA places a number of obligations on employees, including that they must take reasonable care to protect their own health and safety and the health and safety of other persons who may be affected by their conduct. Employees also have the right to leave a dangerous working place whenever circumstances arise at that working place which, with reasonable justification, appear to that employee to pose a serious danger to the health and safety of that employee.

### **4.7 Current Applicable Legislation to Refuge Chambers**

All refuge chamber CoPs are drawn up in accordance with Section 9[1] of the MHSA which states that “any employer may prepare and implement a code of practice on any matter affecting the health or safety of employees and other persons who may be directly affected by activities at the mine” [[Refer to Appendix C](#)].

Further to this, as stated in Section 4.6 above and referring to Section 4.2, there are currently regulations under the Minerals Act, MHSA and Chief Inspector Directives applicable to the use of refuge chambers in underground mines, including coal mines. Tables 4.1 to Table 4.3 refer to applicable legislation regarding refuge chambers in the South African mining industry.

## 4.7.1 Regulations

**Table 4.1 Minerals Act Regulations**

Regulation No	Description Of Current Regulation
24.20.2.1	The manager shall see to it that there is a <u>refuge chamber</u> or other safe place in a mine or works is within easy reach of workmen and within the limits of protection afforded by a self rescuing device, in the event of an explosion, fire or other emergency.
24.20.2.2 (a), (b) and (c)	Definitions and requirements of <u>refuge chamber</u> and other safe place and definition of respirable air. <a href="#">Refer to Appendix D.</a>
24.20.2.3	A <u>refuge chamber</u> and other safe place shall be examined at intervals determined by the manager in consultation with the Inspector of mines, by persons appointed in writing by the manager for this purpose.

**Table 4.2 Mine Health and Safety Act Regulations**

Regulation No	Description Of Current Regulation
16.1(1)	The employer must ensure that a competent person reports to the employer, at appropriate intervals determined in accordance with the mine's risk assessment, on the adequacy of escape and rescue procedures at the mine relating to explosions, fires and flooding.*

Note: \* The competent person referred to in regulations 16.1[1] must be in possession of the Certificate in Mine Environmental Control, issued by the Chamber of Mines of South Africa.

## 4.7.2 Guidelines for Mandatory Codes of Practice

A new "Guideline for the Compilation of a Mandatory Code of Practice for Emergency Preparedness and Response" has been developed and has been approved by the MHSC in January 2007. This Guideline has to be signed off by the Chief Inspector of Mines before it comes into effect.

The scope of this guideline relates to measures or procedures that are established to prepare to respond to and recover from the impact of emergencies but does not address any emergency prevention aspects.

This guideline addresses issues relating to hazard identification and risk assessment, detection and early warning systems, communication systems, first aid equipment and facilities, mine evacuation and escape strategy, rescue and response capabilities, management of emergencies and education, training and awareness.

This guideline will also incorporate four annexes namely:

- Refuge chambers;
- Establishing an emergency control centre, structure and procedure;
- Duties and responsibilities in the emergency control centre; and
- A schedule of additional references

The Annexure on refuge chambers is in principle the old Directive B5 [See Section 4.7.3]. The changes made only reflect the required legalities for CoPs under the MHSA.

### 4.7.3 Chief Inspectors Instructions and Directives

Directive B5 is a directive that was issued under the signature of the Chief Inspector of Mines on the 14<sup>th</sup> February 1994. The aim of Directive B5 is to ensure that refuge chambers are properly sited, constructed, equipped and maintained. The Directive also required Mine Managers to draft a CoP to ensure the effective construction, maintenance and preparedness system for such refuge chambers [[Refer to Appendix E](#)].

### 4.7.4 Guidance Notes

There are no current guidance notes related to refuge chambers.

## 4.8 Mining Qualifications Authority

The Mining Qualifications Authority [MQA] is a statutory body consisting of the State, Employer and Employee organizations in the mining industry. It was established in terms of the MHSA and is a registered Sector Education and Training Authority [SETA] for the Mining and Minerals Sector in terms of the Skills Development Act No 97 of 1998.

The MQA Standards Setting Unit is responsible for administering the functions of the Mining and Minerals Sector Standards Generating Body [M & M SGB]. The SGB is a stakeholder driven body with members from the following six primary stakeholders;

- The State
- Labor;
- Employers;
- Providers of Education and Training;
- Suppliers of Equipment & Services; and
- Mining Professional Associations.

Its main function is to design outcomes-based qualifications and write associated unit standards for registration on the National Qualifications Framework. The Framework is a guideline that presents the range of qualifications, skills programs and possible learnerships identified by the Sector to meet the competency needs in various fields and levels. This Framework is intended to ensure all the various training and development needs of the Sector are addressed at all required levels.

Under this framework various unit standards specifically referring to refuge chambers and escape and rescue training has been developed. These are [[Refer to Appendices E](#), [G](#), and [H](#)]:

- SAQA Unit standard 116533: Demonstrate basic knowledge and understanding of emergency preparedness and response;
- SAQA Unit standard 116513: Examine refuge chambers to ensure they are life sustainable; and
- SAQA Unit standard 48804: National Certificate: Occupational Safety, Hygiene and Environment.

## 4.9 Practicable Guidance from Current Legislation

### 4.9.1 Location and Deployment of Refuge Chambers

Regulation 24.20.2.1 states that “The manager shall see to it that there is a refuge chamber or other safe place in a mine or works are within easy reach of workmen and within the limits of protection afforded by a self rescuing device, in the event of an explosion, fire or other emergency”.

This regulation is further supported by Directive B5 which requires that the manager [employer in the new guidelines] ensures that refuge chambers are positioned at an appropriate place [in areas free of combustible material or combustible material rendered inert in the new guidelines] and within an appropriate distance from the working places. Further due consideration must be given to factors such as:

- The travelling conditions from the workplace e.g. height, walking surface, gradient, possible disorientation, etc.
- The duration of the self-contained self-rescuers used on the mine.

### 4.9.2 Construction and Maintenance

Directive B5 gives clear guidance on the requirements for the construction of refuge chambers. These are as follows:

- Refuge chambers should be of robust construction and where there is a significant risk of explosions it must be able to withstand the effects of such an explosion.
- The size of the refuge chamber should be determined by the maximum number of persons likely to be present in the area served by the refuge chamber, with a minimum floor area of 0.6 m<sup>2</sup> per person.
- Life-sustaining services installed in the refuge chamber should be of fire resistant material or else be fire protected.
- A refuge chamber must be air tight and sealed in such a way so as to ensure a positive pressure that will make the refuge chamber inaccessible to air containing noxious smoke, fumes or gases.
- Refuge chambers should be provided with a man door, and where there is a significant risk of an explosion, a flexible type of door that would not be rendered ineffective in the event of an explosion should be considered.
- Refuge chambers should be provided with seating arrangements where practicable.
- Where applicable, such as at collieries, a surface borehole system, for the provisioning of respirable air to the refuge chamber, may be provided. Access requirements for equipment and vehicles to the borehole site must be taken into account.
- An identification system of refuge chambers must be implemented and must be clearly indicated on the inside and on the outside of the refuge chamber. Where a surface borehole system is used such corresponding identification must also be indicated at the borehole site on surface. This corresponding identification must be indicated on the Mine Rescue Plan contemplated in Regulation 17[19] [[Refer to Appendix I](#)].

In the new guidelines two additional requirements have been put in place. These are:

- Where the life-sustainability of a refuge chamber is dependent on compressed air, the supply to the inside of the refuge chamber should be tamper-free, with a control valve on the inside of the refuge chamber.
- Access arrangements into the refuge chamber should be such that it does not negatively affect the integrity or size of the refuge chamber.

Under the maintenance requirements Directive B5 requires that all refuge chambers be flushed and pressure tested before being commissioned and be repeated at appropriate intervals. Regulation 24.20.2.3 requires that refuge chambers be examined at intervals determined by the manager in consultation with the Inspector of mines, by persons appointed in writing by the manager for this purpose.

#### **4.9.3 Minimum Life Sustaining Equipment Required**

The minimum requirements of rescue chamber to be deemed life sustaining are captured in Regulations 24.20.2.2 (a), (b) and (c) under the Minerals Act and expanded in Directive B5.

Under this legislation a refuge chamber shall at least have the following in it:

- A supply of respirable air unless conditions are such that this is not required;
- Sufficient supply of potable water [at least two liters per person for 24 hours];
- First aid equipment consisting of at least a suitable stretcher, two blankets, and substantially constructed first aid box containing tourniquets, splints, bandages, individually wrapped sterile dressings and antiseptic solution;
- One or more notices on which are legibly printed in simple directions setting forth the approved procedures for the immediate treatment of cases of gassing, heat stroke, heat exhaustion, drowning and electric shock.
- Communication system with surface with relevant contact details of emergency personnel;
- Clearly visible reflective tape with symbolic sign indicating entrance to the refuge chamber;
- A conspicuous light with a reliable independent power supply, or any other physical means placed in such a position in the travelling way so as to indicate the location of the refuge chamber;
- An audible device positioned outside the refuge chamber that can be activated from the inside;
- Toilet facilities; and
- A notice board inside the chamber, displaying the correct procedure to be followed during occupation in an emergency, for example:
  - Activate the ventilation arrangements;
  - Activate the audible device;
  - The most senior person to take charge of the operations and to contact the attendant at the surface control room or any other senior official on the mine;
  - Take roll call;
  - Remain calm and do not move around unnecessarily;
  - Conserve lights. Keep only enough cap lamps on at any one time to provide sufficient illumination;
  - Persons to remain in the refuge chamber until otherwise instructed by the official in charge at the control centre, or rescued; and
  - Keep the door closed during occupation.

#### **4.9.4 Emergency Preparedness and Training**

Section 10 of the MSHA addresses the issue of training [[Refer to Appendix J](#)]. It states that an employer must provide employees with any information, instruction, training or supervision that is necessary to enable them to perform their work safely and without risk to health. No specific mention is made of required training specifically relating to refuge chambers in the MSHA regulations, guidelines, directives or notes. But as the risk of underground explosions and fires has been identified, the employer must provide employees with training regarding emergency response, which would imply the use of refuge chambers.

Under the National Qualifications Network the MQA has developed outcomes based unit standards for underground miners for which they must demonstrate competence. The unit standard titled “Demonstrate basic knowledge and understanding of emergency preparedness and response” require learners to demonstrate the required actions in case of an emergency. This includes the donning of self contained self rescuers and in some cases entering a place of safety [which could include a refuge chamber] and following the procedures. Specifically assessment criterion 4 requires learners to demonstrate the importance of adhering to the symbolic signs in terms of the consequences to health, safety and production.

## 5 IMPLEMENTATION OF REGULATORY GUIDELINES

As required by the MSHA Section 9[1] the employer at any underground mine may prepare and implement a CoP on any matter affecting the health or safety of employees and other persons who may be directly affected by activities at the mine. As the potential of an underground explosion of fire has been identified, and refuge chambers forms part of the emergency response strategy, a CoP specifically for refuge chambers need to drawn up by employers.

Between major and minor mining groups, it was found that the general content and extent of the refuge chamber CoPs was very similar. The only difference is that for the major mining houses the CoP is drawn up internally, and for minor groups external consultants are mostly used to develop their CoPs. This was also found by Van Achtenbergh and Gouws in 2003 [Van Achtenbergh and Gouws, 2003].

From discussions with the people responsible of drawing a refuge chamber CoP, it was found that the work done by Oberholzer in 1997 [Oberholzer, 1997] forms the basis of the inputs to the CoPs. Further to this, the variations observed in the reviewed CoPs is mostly concerned with the equipment used by the mine [e.g. duration of SCSR units, guidance equipment to the refuge chamber, refuge chamber locating devices, etc] and the general mining conditions [e.g. seam height, mining method, surface topology, etc].

At some mine of the mines the leaflet “ResQpacs – How to calculate safe traveling distances”, published by the Research Organization of the Chamber of Mines of South Africa is used as guideline to determine the maximum distance of refuge chambers from working places [COMRO 1998].

The following sections will collate the findings of the review of the practicable aspects of the development of CoPs with specific reference to the following:

- Location and deployment of refuge chambers
- Construction and Maintenance
- Minimum life sustaining equipment required
- Emergency preparedness training

### 5.1.1 Location and Deployment of Refuge Chambers

From the CoPs reviewed it was found that refuge chambers are located at a maximum distance from working places of approximately 1 000 m. This maximum distance from the working places varied from 1 000 m to 660 m. A secondary consideration for locating a refuge chamber is the surface topography. Because South African coal seams are relatively shallow, the preferred method of supplying fresh air, communication, first aid, and sustenance is via surface boreholes. To be able to do this it is strived not to place refuge chamber under dams, structures or private property, were difficulties with access might be a problem. It is strived to place these rescue chambers near access roads and on mine property.

All refuge chambers are clearly marked on the escape and rescue plan and on surface were applicable.



Refuge chambers form an integral part of the escape and rescue strategy in the South African coal mining industry. The escape and rescue strategy developed consists of the following steps:

Don your self-contained-self-rescuer, then, [for most strategies] find the cache of long duration units stored at the production section waiting place, and then proceed to a place of safety.

Two options are available i.e., either reach a place of safety or alternatively reach a fresh air source. Firstly, if visibility is good and the self-contained-self-rescuer will allow you enough time to reach the shaft bottom [or surface], proceed to shaft bottom. Most South African collieries have been operating for decades, and typical distance from the mine shaft is in excess of 8 km – 10 km. This generally prohibits miners from reaching the mine shaft with their self-contained-self-rescuer units. If this is the case refuge chambers are generally deployed to provide places of safety until external help arrives in the form of proto teams or rescue drills from surface for extraction.

The rescue chambers can be permanent or intermediate [fixed or portable] in nature. The major difference between the two types, as reflected in the CoPs, is that permanent refuge chambers are connect to surface via a 160 mm to 200 mm borehole with a fan to force air into the refuge chamber and allow for life sustaining and rescue assistance to be rendered from surface ‘indefinitely’. The intermediate refuge bays however have a limited supply of fresh air and life sustaining assistance is available. The majority of intermediate refuge bays are designed to supply life sustaining assistance for 24 hours, but in some cases 8 hours has been specified. This is based on the rescue strategy of the mine were rescue is expected tot take place within 8 to 24 hours of the incident by proto teams.

### 5.1.2 Construction and Maintenance

Of the reviewed CoPs all refuge chambers are constructed in the coal seam itself. There are various configurations which can be used. Refuge chambers can be either mined into the rib pillar [Figure 5.1], or it can be mined into a special refuge chamber pillar which is left in the general mining area [Figure 5.2], or it can be constructed between pillars left in the workings [Figure 5.3]. For this option, depending on the size, it can be sealed on four sides or on two. In general it is recommended that when a wall is constructed, it not be placed between a return and intake road. This is to minimize the risk of air ingress due to intake and return air road way differential pressure.

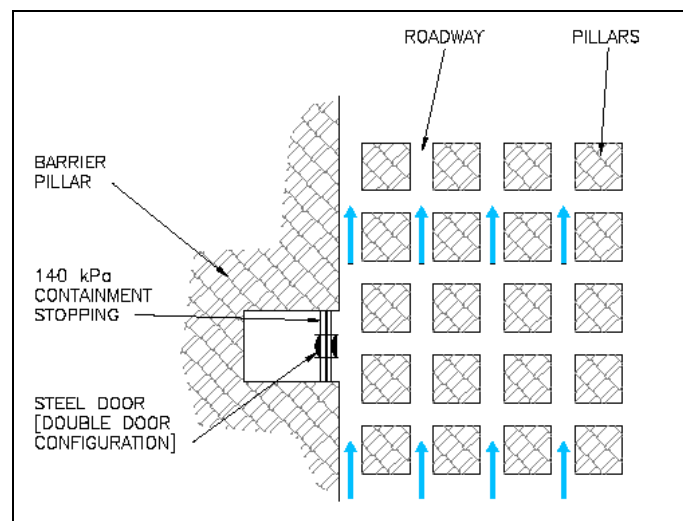


Figure 5.1 Typical configuration of refuge chamber in rib pillar.

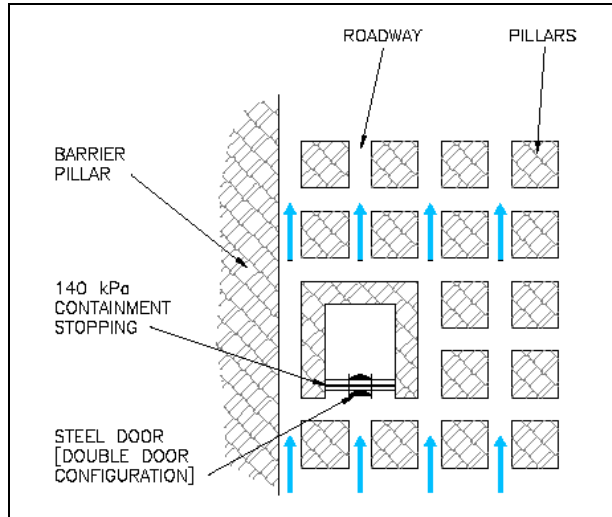


Figure 5.2 Typical configuration of refuge chamber in dedicated refuge chamber pillar.

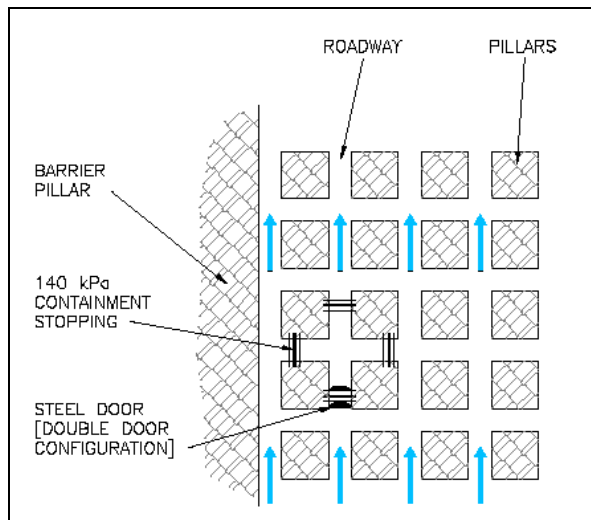


Figure 5.3 Typical configuration of refuge chamber between mined pillars

All the CoPs reviewed required that 140 kPa proof stoppings be used and that non-flammable materials be used for the construction. This is based on the finding of the work done by Oberholzer [Oberholzer, 1997]. Two types of wall construction methods were encountered. Firstly a normal brick wall is constructed and sand bags stacked against it at a 45 ° angle. Alternatively, any method approved by the United States Bureau of Mines is acceptable. This based on the work done by Van der Merwe and Cook in 2000 for SIMRAC [Van der Merwe and Cook, 2000]. The most common method used is the use of a masonry or concrete block construction.

The size of the rescue bay, according to Directive B5 must have a floor area of at least 0.6 m<sup>2</sup> per person. In the CoPs reviewed this value ranged from 1.0 m<sup>2</sup> to 1.5 m<sup>2</sup>.

Entrance methods to the refuge chamber are via steel doors. Single and double door configurations were observed, and no clear preference could be determined. To assist miners to locate refuge chambers in low visibility conditions, three types of methods is generally used. These are either audible locators which are permanently on, or visual locators which are permanently on, or physical locators, or a combination of the three. The audible locators consist of a siren located at the entrance to the refuge bay. Visual locators typically consist of a flashing light [typically red] at the entrance to the refuge chamber. The physical barrier consist of something hanging from the roof to shoulder height in the main travel way and the belt road. Conveyor belting, ropes, mesh wire, plastic sheets etc. has been observed. The principle is that miners will 'bump' into the 'barrier' and know that they must follow the barrier to the refuge chamber.

To further assist the integrity of refuge chambers most CoPs require that an area surrounding the entrance to the refuge bay be covered in stone dust to reduce the potential impact of a coal dust explosion in the region of the refuge bay.

All the requirements of the regulations and directives are met in the CoPs. It has to be mentioned that all the CoPs specifically require that emergency lighting be put in place in a refuge chamber.

Inspections of rescue chambers are done on a daily basis by shift personnel and monthly by mine management and the ventilation department. All maintenance required is done by mining personnel. For permanent refuge chambers the surface condition of the refuge chamber boreholes are regularly inspected to ensure no obstruction is present.

To assist in maintaining the integrity and the life sustaining ability of refuge chambers, most CoPs require that an emergency store be set-up on surface to ensure speedy maintenance to the rescue chambers.

### **5.1.3 Minimum Life Sustaining Equipment Required**

For permanent rescue chambers [i.e. connected to surface] the minimum life sustaining equipment is specified by the regulations and Directive B5 [Refer to Section 4.9.3]. All the CoPs reflect these requirements.

To establish an adequate supply of respirable air, the permanent rescue chambers use an electric fan with back-up batteries to pull fresh air down the borehole into the rescue chamber. Air is expelled under this positive pressure into the mine via a 100 mm pipe no further than 300 mm from the roof of the rescue bay. To further enhance the life sustaining ability of permanent rescue chambers, some CoPs require that a dedicated response trailer be present at the shaft for rapid deployment to the surface location of the borehole. These trailers will typically contain further first aid equipment, communication equipment, fans, water, sustenance, etc.

For intermediate and portable refuge chambers adequate respirable air is ensured by typically three means. The first is to locate further caches of self-contained-self-rescuers in the chamber to ensure sufficient air supply for the duration the risk assessment requires the miners to be rescued. Secondly solid state oxygen generators are used in combination with body worn replaceable soda lime CO<sub>2</sub> filters [Refer to Figures 5.4 and 5.5]. The typical solid state oxygen generator used in the South African mining industry produces approximately 2 900 liters of chemical pure oxygen within 35-50 minutes.



*Figure 5.4 Solid State Oxygen Generator*

The replaceable CO<sub>2</sub> filter cartridges can be used for up to 3 hours @ 90% efficiency [CO<sub>2</sub> <0.5%]



*Figure 5.5 Replaceable CO<sub>2</sub> Filter cartridge.*

Both these options are typically only considered as bridging strategies until permanent refuge chambers can be established or for remote underground operations or for small underground mining operations.

The third option is to use solid state oxygen generators in combination with CO<sub>2</sub> scrubbers and air conditioning units. Typically a 220V/24V battery backed oxygen generating and CO<sub>2</sub> scrubbing system designed to support 24 persons for 24 hours is used. This unit is commercially available and consists of 12 CO<sub>2</sub> filter canisters [10kg each] and 6-8 solid state oxygen generators. The SurvivAir-E was launched at the 1996 Electra Mining Africa Exhibition and was also awarded a gold medal during the April 1997, 25<sup>th</sup> International Exhibition of New Inventions, Technologies and New Products in Genève, Switzerland. More than 100 units have been sold to the South African mining industry [Refer to Figure 5.6].



*Figure 5.6 SurvivAir-E oxygen generation and carbon dioxide scrubbing unit*

#### **5.1.4 Emergency Preparedness and Training**

Training specifically on the use of rescue bays is not specifically addressed in the Refuge Chamber CoPs. Mine personnel however do under go refresher training on all aspects of mine health and safety upon returning from annual leave. This includes emergency preparedness and escape strategies, which encompass the use of refuge chambers.

The new Guideline for Mandatory CoPs for Emergency Preparedness and Response [See section 4.7.2] has a specific section devoted to training and awareness. Section 8.1.5 of the new guideline requires training and awareness to be included in the CoP in order to ensure that all potentially affected persons are educated, trained and made aware on how to deal with emergencies. To achieve this, the guideline requires that the new CoPs must at least cover following:

- The content and frequency of such training [see also section 10[2][d] of MSHA];
- The procedures and appropriate actions to be taken in the event of an emergency, including simulated exercises;
- The correct procedures and applications on the use of emergency equipment;
- The actions required relating to the location and description of shutdown controls/lock out devices;
- Instructions in the use of belt-worn self-contained self-rescuers; and
- The locality of copies of the emergency procedures and instructions.

As part of the training for a general underground mining qualification, training is required by individuals to qualify as underground mine worker [Refer 4.8]. Part of this training includes the use of refuge chambers and the understanding of symbolic instructions in general.

## **6 IMPLEMENTATION OF GUIDELINES OF CODES OF PRACTICE**

An assessment of the practical implementation of Emergency Preparedness and Response Codes of Practice, with specific focus on rescue chambers at major and minor mining operators was conducted. The assessment consisted of site visits, past experience and discussions with the Senior Inspector of Occupational Hygiene for the Witbank area [one the major coal fields in South Africa].

### **6.1 Practicable Application of Codes of Practices**

#### **6.1.1 Location and Deployment of Refuge Chambers**

A major area of concern among major and minor mining operators is to keep the refuge chambers within 1 000m from the working areas.

The use of portable refuge chambers is not yet wide spread in the coal mining industry. One colliery deploys nine portable refuge chambers with success [no operational need required up to date]. Other collieries in the same mining group have each acquired one unit per shaft but it has not been fully deployed in the group yet. Discussions with various other operators [major and minor] regarding the use of portable refuge chambers revealed that they are either unaware or is currently unconvinced about the deployment of portable refuge chambers.

#### **6.1.2 Construction and Maintenance**

It was found that although the CoP in general requires 140 kPa stoppings to be constructed, the majority of refuge chambers do not comply with this standard.

Various entrance methods were observed for refuge chambers, ranging from single steel doors, to double steel doors, to pipe type entrances.

In general it was found that refuge chambers are well maintained and comply with the minimum requirements. It has to be noted that most refuge chambers has provision for emergency lighting. The biggest non compliance was supply of fresh potable water, as most of the refuge chambers do not have a dedicated water supply and replacing the potable water on regular basis is a cumbersome process.

#### **6.1.3 Minimum Life Sustaining Equipment Required**

In general the minimum life sustaining equipment is in good working order and inspections are carried out as per schedule and maintenance conducted.

#### **6.1.4 Emergency Preparedness and Training**

On mine refresher training was found to vary from mine to mine, even within mining houses. In general self-contained-self-rescuer training was conducted adequately. The only training directly related to refuge bays was periodic escape drills from the workplace to the refuge chambers.

Some mining houses make it compulsory for all employees to attend an explosion awareness program developed by the CSIR Kloppersbos explosion test facility [[Refer to Appendix K](#)]. As part of the training the learners are shown the condition of the atmosphere immediately after a coal dust explosion in a 200 m test gallery [Refer to Figure 6.1].



*Figure 6.1 The coal dust explosion learners are exposed to during the CSIR explosion awareness program*

## **7 PERFORMANCE ASSESSMENT OF RESCUE CHAMBERS**

Apart from the required flushing and pressure testing of refuge chambers no specific standards applicable to the performance testing of refuge chambers could be identified.

## 8 MOBILE RESCUE CHAMBERS IN SOUTH AFRICAN MINING INDUSTRY

### 8.1 Suppliers of Mobile Rescue Chamber in South Africa

In South Africa there is one local supplier of mobile underground refuge chambers. The company is BroKrew Industrial [Pty] Ltd and they manufacture and maintain the Survivair-RCC. Their contact details can be found at [www.brokrew.co.za](http://www.brokrew.co.za). The company is ISO:9001:2000 accredited.

They supply mobile rescue chambers to the South African underground coal mining industry, South African underground platinum industry, South African tunnelling industry [Gautrain project], Australian copper mining industry and they also supply solid state oxygen generators to Canada.

The specifications of the flagship of the Survivair-RCC/Rescueair-ERB technology product range are as follows:

- Air tight, insulated / un-insulated steel constructed refuge chamber
- CO/CO<sub>2</sub> scrubbing system
- Air Conditioner/de-humidifier system
- Battery Backed AC Power Inverter System
- Survivair Oxygen Generators

Options for the Survivair-RCC include:

- 3.4m 8 Person/12 Hour unit
- 3.4m 12 Person/18 Hour unit
- 4.5m 14 Person/24 Hour unit



Figure 8.1 The Survivair-RCC/Rescueair-ERB



The product range also includes a low seam Survivair-RCC/Rescueair-ERB. The low seam version has the same operating specifications as the flagship unit but have different dimensions to be able to be deployed in low seam applications. The dimensions are 1.7 m H x 2.0 m W x 6 m L. Options include the following:

- 3.4m 12 Person/18 Hour unit
- 4.5m 14 Person/24 Hour unit
- 6.0m 16 Person/24 Hour unit



*Figure 8.2 The low seam Survivair-RCC/Rescueair-ERB*

## 8.2 The Survivair Mobile Rescue Chamber

The Survivair mobile refuge chamber was developed in South Africa from 1987 to 1997 in a joint venture between BroKrew and Naschem, a Division of Denel. The approach was to start off with a low tech solution [[Appendix K](#)] and increase the complexity until a life sustaining unit was developed.

The initial requirements for the mobile rescue chambers were set as follows:

- Self sufficient to ensure that 12 workers have respirable air for a period of 24 hours [respirable air = oxygen > than 18% and CO<sub>2</sub> < 0.5%].
- Ensure an appropriate environment in terms of temperature and relative humidity [20 – 25°C en 60 – 80% RH)
- Durable construction to handle underground seismic activity and explosions.
- Supply visual and audible alarms for easy identification.
- Modular design for easy transportation and adaptability to increase size as required.
- Entrance to the refuge chamber through an air curtain.
- Must be able to operate in an irrespirable atmosphere.
- Must be designed to ensure that a positive pressure is maintained inside the refuge chamber so as to prevent the ingress of noxious gases or fumes.
- Must be designed to be air tight.
- Must be equipped with water, first aid equipment and toilet facilities.
- Equipped with a means of communication to surface of the mine.
- To be mounted on ski's to ensure portability.
- Easy access to be guaranteed.
- Must be easy to operate.
- Independent of external power supply and should be able to function independently.
- Must be sited as close to the working place as possible [within non-flame proof distance].
- Must have a fire rating of 1 hour.

The basic concept was to design an air tight chamber and use solid state oxygen generators to replenish oxygen and use a soda lime scrubber to remove metabolically generated carbon dioxide [Venter *et al* 1999].

In developing the life sustaining design parameters standards from NASA, Canada Ontario Province, Australia and applicable US standards were consulted. After exhaustive testing, including human subject evaluation, design parameters for oxygen consumption, metabolic carbon dioxide generation and heat generation was developed. Based on this the following guidelines can be used when developing a life sustaining system in an airtight chamber [De Klerk, 2007 and Venter, 2007]:

- Initial oxygen concentration 20.95 %
- Initial Carbon Dioxide 300 ppm
- Carbon Dioxide maximum 5000 ppm
- Oxygen minimum 19 %
- 30 Liters of oxygen/person/hour
- 24 Liters Carbon Dioxide/person/hour
- Heat produced 150-250 Watt per person

Apart from the life sustaining standards various other regulations were consulted. These included:

- Public Transport Guidelines for Seating Arrangements
- Australian Electrical Standards [The unit is not intrinsically safe nor flameproof]

The unit is supplied to the mines with a maintenance manual and user manual. Typically a service contract will be entered into, where the units are serviced every three years with the main reason being battery life and general equipment maintenance.

## 9 LIST OF RELEVANT FURTHER INFORMATION SOURCES

1. The Mine Health and Safety Act of 1996 can be found at <http://www.acts.co.za/mhs/index.htm>
2. The MQA website is <http://www.mqa.org.za>
3. DME Website on Guidelines is <http://www.dme.gov.za/mhs/documents.stm>
4. The SIMRAC website can be found at <http://www.simrac.co.za/>. Relevant reports can be found in the Explosions and Fires and Special Projects sections.

## 10 REFERENCES

1. COMRO. Chamber of Mines of South Africa Research Organization. ResQpacs-How to calculate safe traveling distances. *Information Leaflet No 46, November 1989.*
2. De Klerk C. Mines Rescue Services [South Africa]. *Personal communication July 2007.*
3. Oberhozer JW. Assessment of refuge bay designs in collieries. *COL 115 SIMRAC Final Research Report, January 1997.*
4. Van Achtenbergh A and Gouws MJ. Prevention based health and safety regulatory mechanisms – the South African experience, *ISSA/Chamber of Mines Conference 2003 – Mines and Quarries: Prevention of Occupational Injury and Disease, 2003.*
5. Van der Merwe JN and Cook AP. Design, construction and testing of underground seals. *COL 502 SIMRAC Final Research Report, January 2000.*
6. Venter JM *et al.* Portable refuge chambers: Aid or tomb in underground escape strategies. *Journal of the Mine Ventilation Society of South Africa, January/March 1999.*
7. Venter JM. Naschem. *Personal communication, September 2007.*

## **APPENDIX A: MINE HEALTH AND SAFETY ACT, 1996 SCHEDULE 4 - TRANSITIONAL PROVISIONS**

1. Any health and safety standard which, immediately prior to the commencement of this Act, was incorporated under the provisions of the Minerals Act or the regulations made under that Act is deemed to be a health and safety standard incorporated under this item.
2. A certificate of fitness issued under the provisions of the Occupational Diseases in Mines and Works Act, 1973 (Act No. 78 of 1973), which was valid immediately before the commencement of this Act shall be deemed to be sufficient proof that the employee is fit to perform work until the certificate is cancelled or expires.
3. A declaration in respect of any work which has been declared under the Occupational Diseases in Mines and Works Act, 1973 (Act No. 78 of 1973), to be risk work at controlled mines is deemed to be a declaration made under section 76(1) of this Act and remains in force until the declaration is withdrawn or superseded under this Act.
4. Any regulation made or deemed to be made under the Minerals Act that relate to health and safety issues that can be regulated under this Act, may be amended under this Act and remains in force until repealed under this Act.
5. To the extent that it grants exemptions from the operation of a provision similar to a provision of this Act, an exemption is deemed to have been granted under section 79 if-
  - a. it was granted under the provisions of the Minerals Act; and
  - b. it is still in force when this Act commences.
6. Section 85 does not apply to an employee employed at any mine immediately before the commencement of that section.

## **APPENDIX B: MINE HEALTH AND SAFETY ACT, 1996, CHAPTER 4, TRIPARTITE INSTITUTIONS 41 - ESTABLISHMENT OF TRIPARTITE INSTITUTIONS**

- 1) A Mine Health and Safety Council is hereby established to advise the Minister on health and safety at mines.
- 2) The following permanent committees of the Council are hereby established--
  - a) the Mining Regulation Advisory Committee;
  - b) the Mining Occupational Health Advisory Committee; and
  - c) the Safety in Mines Research Advisory Committee.
- 3) A Mining Qualifications Authority is hereby established to advise the Minister on--
  - a) qualifications and learning achievements in the mining industry to improve health and safety standards through proper training and education;
  - b) standards and competency setting, assessment, examinations, quality assurance and accreditation in the mining industry; and
  - c) proposals for the registration of education and training standards and qualifications in the mining industry on the National Qualifications Framework referred to in the South African Qualifications Authority Act, 1995 (Act No. 58 of 1995).  
*(The South African Qualifications Authority Act provides for a National Qualifications Framework which aims to enhance the quality of education and training.)*

## **APPENDIX C: MINE HEALTH AND SAFETY ACT, 1996 CHAPTER 2, SECTION 9 - CODES OF PRACTICE**

- 1) Any employer may prepare and implement a code of practice on any matter affecting the health or safety of employees and other persons who may be directly affected by activities at the mine.
- 2) An employer must prepare and implement a code of practice on any matter affecting the health or safety of employees and other persons who may be directly affected by activities at the mine if the Chief Inspector of Mines requires it.
- 3) A code of practice required by the Chief Inspector of Mines must comply with guidelines issued by the Chief Inspector of Mines.
- 4) The employer must consult with the health and safety committee on the preparation, implementation or revision of any code of practice.
- 5) The employer must deliver a copy of every code of practice prepared in terms of subsection (2) to the Chief Inspector of Mines.
- 6) The Chief Inspector of Mines must review a code of practice of a mine if requested to do so by a registered trade union with members at the mine, or a health and safety committee or a health and safety representative at the mine.
- 7) At any time, an inspector may instruct an employer to review any code of practice within a specified period if that code of practice--
  - a) does not comply with a guideline of the Chief Inspector of Mines; or
  - b) is inadequate to protect the health or safety of employees.

## APPENDIX D: MINERALS ACT REGULATIONS (IN FORCE IN TERMS OF SECTION 4 OF THE MHSA)

24.20.2.2 For the purposes of these regulations -

- (a) “refuge chamber” shall mean a place in the underground workings which is inaccessible to air containing noxious smoke, fumes or gases and which shall be having regard to the maximum number of persons likely to be present in the area served by the refuge chamber –
  - (i) equipped with means for the supply of respirable air unless conditions are such that this is not required;
  - (ii) equipped with a sufficient supply of potable water;
  - (iii) equipped with the first aid equipment referred to in regulation 24.1.1;
  - (iv) of sufficient size to accommodate that number of persons;
  - (v) equipped with an apparatus referred to in regulation 24.6; and situated where possible, in an area free of combustible material;
- (b) “other safe place” shall mean –
  - (i) the surface of the mine or works; or
  - (ii) an intake airway commencing from the surface of the mine or works, which contains no combustible material or in which all combustible material has been rendered fire-resistant and in which all combustible material in quantities sufficient to endanger or likely to endanger the safety of somebody is conveyed during the working shifts; or
  - (iii) a selected place in the underground working where additional self-rescuing devices approved by the Chief Inspector are stored ready for use, sufficient in number to provide for the number of persons likely to make use of such devices, and of adequate duration to reach refuge chamber or other safe place; and
- (c) “respirable air” shall mean air, the quality of which complies with the provision of regulation 10.6.6 [repealed and replaced by Chapter 22 Tables Occupational Exposure/Control Limits] and is not contaminated by another substance which is harmful or likely to be harmful.
  - “self contained rescuing device” shall mean a device which provides respirable air, independent of the surrounding atmosphere to protect the wearer from exposure to irrespirable air.

24.1.1 Where the number of persons employed on surface including opencast workings, at any one time is 300 or less, there shall be kept in a readily accessible, clean and dry place a suitable stretcher, provided with 2 blankets, and substantially constructed first aid box containing tourniquets, splints, bandages, individually wrapped sterile dressings and antiseptic solution.

24.6 One or more notices on which are legibly printed in both official languages simple directions setting forth the approved procedures for the immediate treatment of cases of gassing, heat stroke, heat exhaustion, drowning and electric shock shall be posted up in a conspicuous place in every change house and in every first aid room.

# APPENDIX E: DIRECTIVE B 5

81/172892  
(Z 28)



## DEPARTMENT OF MINERAL AND ENERGY AFFAIRS

**DIRECTIVE NO** : B 5      **EFFECTIVE DATE:** 14 February 1994

**SUBJECT** : A Guideline For The Siting, Construction, Equipping And Maintaining Of Refuge Bays

**SCOPE** : This directive is applicable to all mine safety and health enforcement personnel and Managers of all mines with underground workings for guidance in the compliance with the provisions contained in the Minerals Act, Regulation 24.20.2.1 to ensure that refuge bays are properly sited, constructed, equipped and maintained.

**PURPOSE** : The purpose of this directive and addendum is to guide regional directors and mine management in the compilation and approval of a code of practice relating to refuge bays.

**DIRECTIVE** : Regional Directors must request a code of practice in terms of Section 34(1) of the Minerals Act, to be drawn up by managers of all mines where refuge bays are legally required, in order to ensure an effective construction, maintenance and preparedness system for such refuge bays.

**AUTHORITY** : Government Mining Engineer


**ISSUING OFFICE** : Director General

**DISTRIBUTION** : Government Mining Engineer

Chief Directors:      Mining Safety  
                                 Mining Equipment Safety  
                                 Mine Environmental Control  
                                 and Rehabilitation

Directors:              Mining Safety  
                                 Mining Equipment Safety  
                                 Mine Environmental Control

Regional Directors:      PWV Region  
                                 Northern Transvaal Region  
                                 Eastern Transvaal Region  
                                 Western Transvaal Region  
                                 Natal Region  
                                 Orange Free State Region  
                                 Eastern Cape Region  
                                 Northern Cape Region  
                                 Western Cape Region

  
GOVERNMENT MINING ENGINEER  
DIRECTOR GENERAL  
SITTERT\M\REFBAYS



## GUIDELINES FOR REFUGE BAYS

### 1. OBJECTIVE

To provide a guideline and general framework for the siting, construction, equipping and maintenance of refuge bays.

### 2. SITING / LOCATION

The position of a refuge bay must be determined by the manager in charge of the section in consultation with his Environmental Control Officer/Ventilation Official (Person appointed in terms of Regulation 2.16.1.1), and to be positioned at an appropriate distance from the working places, with due consideration given to factors such as:

- (i) the travelling conditions from the workplace e.g. height, walking surface, gradient, possible disorientation, etc.
- (ii) the capacity of the self contained rescuing device apparatus used on the mine.

### 3. CONSTRUCTION / DESIGN

- 3.1 Refuge bays must be of robust construction and where there is a high risk of explosions it must be able to withstand the effects of such an explosion.
- 3.2 Refuge bays must be designed for the maximum number of persons in the section that it will serve, with a minimum floor area of 0,6 m<sup>2</sup> per person.
- 3.3 Service piping to the refuge bay should be of fire resistant material or else be fire protected.
- 3.4 Bay to be air leak proof, sealed in such a way so as to ensure a positive pressure when in use.
- 3.5 Provided with an access mandoor, and where there is a high risk of an explosion, a flexible type of door should be considered.
- 3.6 Provided with seating arrangements.
- 3.7 Where applicable an effective surface borehole with proper surface site installations, e.g. ventilation fans may be provided, taking into account access requirements for equipment and vehicles to the borehole site.
- 3.8 For identification and control purposes, the refuge bay must be clearly and suitably numbered both on the inside and on the outside of the bay and on surface, where applicable, for easy identification. Those numbers must also appear on the corresponding refuge bays indicated on the Mine Rescue Plan.

#### 4. EQUIPMENT / FACILITIES

- 4.1 Supply of potable water (A minimum of 2 litres per person for 24 hours is recommended).
- 4.2 A telephone for communication between surface and underground. The appropriate emergency telephone numbers must be displayed.
- 4.3 A clearly visible reflective type "Refuge Bay" symbolic sign to be displayed at the entrance to the bay.
- 4.4 A conspicuous light with a reliable power supply or any other physical means placed in such a position in the travelling way so as to indicate the location of the refuge bay.
- 4.5 An audible signalling device positioned outside the bay and activated from the inside.
- 4.6 Toilet facilities
- 4.7 First aid equipment. May also be used as an optional first aid station.
- 4.8 A notice board inside the bay, displaying the correct procedure to be followed during occupation in an emergency, for example:
  - Activate the ventilation arrangements.
  - Activate the audible signalling device.
  - The most senior person to take charge of the operations and to contact the attendant at the surface control room or any other senior official on the mine.
  - Take roll-call.
  - Remain calm and do not move around unnecessarily.
  - Conserve lights. Keep only enough caplamps on at any one time to provide sufficient illumination.
  - Persons to remain in bay until otherwise instructed by the official in charge at the control room, or rescued.
  - Keep door closed during occupation.

#### 5. VENTILATION ARRANGEMENTS

A reliable source of respirable air must be supplied to the bay so as to ensure proper flushing and create a positive pressure. Where compressed air is used an arrangement for silencing must be provided.

#### 6. MAINTENANCE / INSPECTIONS

- 6.1 All equipment and facilities as outlined in items 4.1 through 4.8 and paragraph 5 shall be routinely inspected by persons designated and appointed for this purpose to ensure that the refuge bay and facilities are in constant good order. Records of reports must be kept.
- 6.2 Flushing and pressurization tests must be conducted on all refuge bays before being commissioned.

## 7. ESCAPE ROUTES AND EVACUATION DRILLS

- 7.1 Escape routes to refuge bays and alternative fresh air routes shall be clearly marked, on a plan to be kept on surface and up-dated monthly by a person appointed by the Manager in consultation with the Environmental/Ventilation Officer (Person appointed under Regulation 2.16.1.1).
- 7.2 These routes must be clearly marked underground with the recognised symbolic signs or other physical means.
- 7.3 Supervisors shall ensure that all workers are familiar with these routes.
- 7.4 Management shall ensure that all persons are adequately trained in the evacuation drill and procedures in event of emergencies. Records to be kept of all drills performed.

## 8. CONTROL / REVIEW

Refuge bay procedures, the locality of bays and escape strategies are to be reviewed at intervals determined by the Manager in charge.

SITTERT\AM\BAYGUID

# APPENDIX F: UNIT STANDARD FOR UNDERSTANDING OF BASIC EMERGENCY PREPAREDNESS AND RESPONSE



*All qualifications and unit standards registered on the National Qualifications Framework are public property. Thus the only payment that can be made for them is for service and reproduction. It is illegal to sell this material for profit. If the material is reproduced or quoted, the South African Qualifications Authority (SAQA) should be acknowledged as the source.*

## SOUTH AFRICAN QUALIFICATIONS AUTHORITY REGISTERED UNIT STANDARD:

### Demonstrate basic knowledge and understanding of emergency preparedness and response

SAQA US ID	UNIT STANDARD TITLE		
116533	Demonstrate basic knowledge and understanding of emergency preparedness and response		
SGB NAME		REGISTERING PROVIDER	
SGB Occupational Health and Safety			
FIELD	SUBFIELD		
Field 09 - Health Sciences and Social Services	Preventive Health		
ABET BAND	UNIT STANDARD TYPE	NQF LEVEL	CREDITS
Undefined	Regular-Fundamental	Level 2	2
REGISTRATION STATUS	REGISTRATION START DATE	REGISTRATION END DATE	SAQA DECISION NUMBER
Reregistered	2007-08-07	2010-08-07	SAQA 0160/05

#### PURPOSE OF THE UNIT STANDARD

This unit standard requires learners to demonstrate basic knowledge and understanding of emergency preparedness and response. Learners credited with this unit standard are capable of:

- Discussing the different types of emergencies that may be encountered in the workplace
- Explaining emergency preparedness and demonstrating response appropriate to the situation

#### LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING

The Unit Standard outcomes and credits are based on the assumption that learners attempting this Unit Standard can already read, write and communicate at ABET 3 or equivalent.

#### UNIT STANDARD RANGE

Specific range statements are provided in the body of the unit standard where they apply to particular specific outcomes or assessment criteria. Note: Emergencies must include: Floods, Fires, Explosions, Seismic events, power failures, Emission of gas, sudden release of gases, Chemical incidents, and equipment failure.

#### UNIT STANDARD OUTCOME HEADER

N/A

### Specific Outcomes and Assessment Criteria:

### **SPECIFIC OUTCOME 1**

Discuss different types of emergencies that may be encountered in a workplace.

### **ASSESSMENT CRITERIA**

#### **ASSESSMENT CRITERION 1**

Different types of emergencies that may be encountered in a workplace are listed and are according to specified requirements.

#### **ASSESSMENT CRITERION 2**

Effects that these emergencies in the workplace may have on worker health and safety is described in accordance with specified requirements.

#### **ASSESSMENT CRITERION 3**

The purpose of warning, mandatory, statutory and informative signs is explained and is according to specified requirements.

#### **ASSESSMENT CRITERION 4**

The importance of adhering to the symbolic signs is explained in terms of the consequences to health, safety and production.

### **SPECIFIC OUTCOME 2**

Explaining emergency preparedness and demonstrating response appropriate to the situation.

### **ASSESSMENT CRITERIA**

#### **ASSESSMENT CRITERION 1**

Explanation of immediate personal action to be taken, in the event of an emergency, is in accordance with specified requirements.

#### **ASSESSMENT CRITERION RANGE**

Personal action includes: withdrawal, warning of other workers, reporting, first aid treatment and donning of self-contained-self-rescuer.

#### **ASSESSMENT CRITERION 2**

Emergency preparedness is explained in terms of specified requirements.

#### **ASSESSMENT CRITERION 3**

Explanation of restricted and confined areas, traveling ways and escape routes is according to specified requirements.

#### **ASSESSMENT CRITERION 4**

Demonstrations of actions to be taken during prescribed situations confirm understanding of specified requirements.

### **UNIT STANDARD ACCREDITATION AND MODERATION OPTIONS**

Assessment of learner achievements takes place at providers accredited by a relevant ETQA (RSA, 1998b) for the provision of programs that result in the outcomes specified for this unit standard. Anyone assessing a learner against this unit standard must be registered as an assessor with a relevant ETQA. Any institution offering learning that will enable achievement of this unit standard must be accredited as a provider with a relevant ETQA. The relevant ETQA according to the moderation guidelines and the agreed ETQA procedures will oversee moderation of assessment and is responsible for moderation of learner achievements of learners who meet the requirements of this unit standard.

### **UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE**

Essential embedded knowledge will be assessed through assessment of the specific outcomes in terms of the stipulated assessment criteria. Learners are unlikely to achieve all the specific outcomes, to the standards described in the assessment criteria, without knowledge of the listed embedded knowledge. This means that for the most part, the possession or lack of the knowledge can be directly inferred from the quality of the learner's performance. Where direct assessment of knowledge is required, assessment criteria have been included in the body of the unit standard.

Credited learners understand and can explain:

- Legal and specified requirements
- The different types of emergencies that may be encountered in the workplace

- Emergency preparedness

#### **UNIT STANDARD DEVELOPMENTAL OUTCOME**

N/A

#### **UNIT STANDARD LINKAGES**

N/A

### **Critical Cross-field Outcomes (CCFO):**

#### **UNIT STANDARD CCFO IDENTIFYING**

Identify and solve problems and make decisions using critical and creative thinking. Note: The ability of the learner to interpret emergency situations contributes to his/her problem solving skills.

#### **UNIT STANDARD CCFO WORKING**

Work effectively with others as members of a team, group, organisation or community. Note: The ability and willingness of the learner to accept, interpret and delegate work instructions correctly, when and if required, in an appropriate manner indicates that he/she can work effectively as a team member in the bigger organisational structure.

#### **UNIT STANDARD CCFO ORGANISING**

Organize and manage themselves and their activities responsibly and effectively. Note: Competence in applying acquired knowledge will indicate that the learner can organize and manage activities in his/her working environment.

#### **UNIT STANDARD CCFO COLLECTING**

Collect, analyze, organize and critically evaluate information. Note: The ability of the learner to evaluate and interpret situations will indicate proficiency.

#### **UNIT STANDARD CCFO COMMUNICATING**

Communicate effectively, using visual, mathematical and / or language skills in the modes of oral and / or written presentations. Note: The ability of the learner to use visual, mathematical and language skills will indicate his/her effectiveness to communicate information in the modes of oral and written presentations.

#### **UNIT STANDARD CCFO SCIENCE**

Use science and technology effectively and critically showing responsibility towards the environment and health of others.

#### **UNIT STANDARD CCFO DEMONSTRATING**

Demonstrate an understanding of the world as a set of related systems by recognizing that problem-solving contexts do not exist in isolation. Note: The ability of the learner to identify and refer anomalous behaviour to a specialist confirms understanding that a specific observation, inference, action or decision can have an interrelated effect.

#### **UNIT STANDARD ASSESSOR CRITERIA**

Assessors should keep the following principles in mind when designing and conducting assessments against this unit standard:

- Focus the assessment activities on gathering evidence in terms of the main outcome expressed in the title to ensure assessment is integrated rather than fragmented. Remember we want to declare the learner competent in terms of the title. Where assessment at title level is unmanageable, then focus assessment around each specific outcome, or groups of specific outcomes.
- Make sure evidence is gathered across the entire range, wherever it applies. Assessment activities should be as close to the real performance as possible, and where simulations or role-plays are used, there should be supporting evidence to show the learner is able to perform in the real situation.
- Do not focus the assessment activities on each assessment criterion. Rather make sure the assessment activities focus on outcomes and are sufficient to enable evidence to be gathered around all the assessment criteria.
- The assessment criteria provide the specifications against which assessment judgements should be made. In most cases, knowledge can be inferred from the quality of the performances, but in other cases, knowledge and

understanding will have to be tested through questioning techniques. Where this is required, there will be assessment criteria to specify the standard required.

- The task of the assessor is to gather sufficient evidence, of the prescribed type and quality, as specified in this unit standard, that the learner can achieve the outcomes again and again and again. This means assessors will have to judge how many repeat performances are required before they believe the performance is reproducible.
- All assessments should be conducted in line with the following well documented principles of assessment: appropriateness, fairness, manageability, integration into work or learning, validity, direct, authentic, sufficient, systematic, open and consistent.

#### UNIT STANDARD NOTES

Specified requirements include legal and site-specific requirements and are contained in one or more of the following documents:

Legal requirements:

- OHS Act and Regulations 85 / 1993
- Mine Health and Safety Act and Regulations 29/1996
- Guideline for mandatory Codes of Practice

Site-specific requirements:

- Managerial instructions
- Codes of Practice
- Company Standards
- Standard Task Procedures
- Health Management Programme
- Risk Assessment Documentation
- Working Guides
- Manufacturers` specifications.

#### QUALIFICATIONS UTILISING THIS UNIT STANDARD:

	ID	QUALIFICATION TITLE	LEVEL	STATUS	END DATE
Core	<a href="#">48804</a>	National Certificate: Occupational Safety, Hygiene and Environment	Level 2	Reregistered	2010-08-07
Core	<a href="#">21842</a>	National Certificate: Surface Mining Rock breaking	Level 2	Reregistered	2009-11-07
Core	<a href="#">57121</a>	National Certificate: Rock breaking: Quarrying	Level 3	Registered	2009-11-16
Elective	<a href="#">58722</a>	National Certificate: Engineering Fabrication	Level 2	Registered	2010-08-16

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# APPENDIX G: UNIT STANDARD FOR REFUGE CHAMBER EXAMINATION



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## SOUTH AFRICAN QUALIFICATIONS AUTHORITY REGISTERED UNIT STANDARD:

### Examine refuge chambers to ensure they are life sustainable

SAQA US ID	UNIT STANDARD TITLE		
116513	Examine refuge chambers to ensure they are life sustainable		
SGB NAME		REGISTERING PROVIDER	
SGB Occupational Health and Safety			
FIELD	SUBFIELD		
Field 09 - Health Sciences and Social Services	Preventive Health		
ABET BAND	UNIT STANDARD TYPE	NQF LEVEL	CREDITS
Undefined	Regular-Fundamental	Level 2	1
REGISTRATION STATUS	REGISTRATION START DATE	REGISTRATION END DATE	SAQA DECISION NUMBER
Reregistered	2007-08-07	2010-08-07	SAQA 0160/05

#### PURPOSE OF THE UNIT STANDARD

This unit standard requires learners to be able to examine refuge chambers to ensure that they are life sustainable. Learners credited with this unit standard are capable of:

- Describing the specified requirements pertaining to the examination of refuge chambers
- Preparing to examine refuge chambers
- Examine refuge chambers
- Performing post refuge chamber examination activities

#### LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING

The ability to read and write at ABET level 3 or equivalent will facilitate better understanding and demonstrate proficiency in this unit standard.

#### UNIT STANDARD RANGE

Specific range statements are provided in the body of the unit standard where they apply to particular specific outcomes or assessment criteria.

#### UNIT STANDARD OUTCOME HEADER

N/A

### Specific Outcomes and Assessment Criteria:

#### SPECIFIC OUTCOME 1

Describe the specified requirements pertaining to the examination of a refuge chamber.

#### ASSESSMENT CRITERIA



**ASSESSMENT CRITERION 1**

Explanation of the function of a refuge chamber is consistent with specified requirements.

**ASSESSMENT CRITERION 2**

The description, equipment and operation of a refuge chamber are consistent with specified requirements.

**ASSESSMENT CRITERION 3**

The consequences of not examining a refuge chamber are explained in accordance with specified requirements.

**SPECIFIC OUTCOME 2**

Prepare to examine the refuge chambers.

**ASSESSMENT CRITERIA****ASSESSMENT CRITERION 1**

The examination and use of the required personal protective equipment is according to specified requirements.

**ASSESSMENT CRITERION 2**

The importance of examination and use of the required personal protective equipment is explained in terms of the consequences to health and safety.

**ASSESSMENT CRITERION 3**

The selection of the relevant refuge chamber to be examined, reviewing of previous examination results and confirmation of access route is consistent with specified requirements.

**ASSESSMENT CRITERION 4**

The required instruments are inspected and verified according to specified requirements.

**ASSESSMENT CRITERION 5**

The importance of inspecting the instruments is explained in terms of the consequences to health and safety.

**ASSESSMENT CRITERION 6**

The preparation work is performed in a manner that fosters teamwork and avoids conflict.

**SPECIFIC OUTCOME 3**

Examine refuge chamber.

**ASSESSMENT CRITERIA****ASSESSMENT CRITERION 1**

The route to the refuge chamber is examined and hazards and risks pertaining to health and safety are dealt with according to specified requirements.

**ASSESSMENT CRITERION 2**

The importance of examining the route and dealing with hazards and risks are explained in terms of the possible consequences to health and safety.

**ASSESSMENT CRITERION 3**

The refuge chamber is examined and hazards and risks pertaining to health and safety are dealt with according to specified requirements.

**ASSESSMENT CRITERION 4**

The importance of examining the refuge chamber and dealing with sub standard conditions is explained in terms of the possible consequences to health and safety.

**ASSESSMENT CRITERION 5**

The measurements of the environmental conditions in the refuge chamber are performed according to specified requirements.

**ASSESSMENT CRITERION 6**

The results of the examination and measurements are recorded according to specified requirements.

**ASSESSMENT CRITERION 7**

The examination is done in a manner that fosters teamwork and avoids conflict.

#### **SPECIFIC OUTCOME 4**

Perform post examination activities.

#### **ASSESSMENT CRITERIA**

##### **ASSESSMENT CRITERION 1**

Reports are complete, accurate, in the required format and submitted to the designated personnel on time.

##### **ASSESSMENT CRITERION 2**

The measuring equipment are cleaned and stored according to specified requirements.

##### **ASSESSMENT CRITERION 3**

Defective measuring equipment is dealt with according to specified requirements.

#### **UNIT STANDARD ACCREDITATION AND MODERATION OPTIONS**

#### **UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE**

Essential embedded knowledge will be assessed through assessment of the specific outcomes in terms of the stipulated assessment criteria. Learners are unlikely to achieve all the specific outcomes, to the standards described in the assessment criteria, without knowledge of the listed embedded knowledge. This means that for the most part, the possession or lack of the knowledge can be directly inferred from the quality of the learner's performance. Where direct assessment of knowledge is required, assessment criteria have been included in the body of the unit standard.

Credited learners understand and can explain:

- Legal and site-specific requirements
- The function of a refuge chamber
- Equipment and operation of a refuge chamber
- The consequences of not examining a refuge chamber
- The examination and use of the required personal protective equipment
- The importance of examination and use of the required personal protective equipment
- The selection of the relevant refuge chamber to be examined, reviewing of previous examination results and confirmation of access route
- How the refuge chamber is examined and hazards and risks pertaining to health and safety are dealt with
- The importance of examining the refuge chamber and dealing with sub standard conditions
- How the measurements of the environmental conditions in the refuge chamber are performed
- How the results of the examination and measurements are recorded
- How defective measuring equipment is dealt with

#### **UNIT STANDARD DEVELOPMENTAL OUTCOME**

N/A

#### **UNIT STANDARD LINKAGES**

N/A

### **Critical Cross-field Outcomes (CCFO):**

#### **UNIT STANDARD CCFO IDENTIFYING**

Identify and solve problems and make decisions using critical and creative thinking. Note: The ability of the learner to identify problems in terms of refuge chambers and making recommendations indicates that he/she can solve problems.

#### **UNIT STANDARD CCFO WORKING**

Work effectively with others as a member of a team/group/organization/community. Note: The ability and willingness of the learner to accept, interpret and delegate work instructions correctly, if and when required, in an appropriate manner indicates that he/she can work effectively as a team member in the bigger organizational structure.

#### **UNIT STANDARD CCFO ORGANISING**

Organise and manage oneself and one's activities responsibly and effectively. Note: The identification of the correct instruments and procedure will indicate that the learner can organise and manage activities in his/her working environment.

#### **UNIT STANDARD CCFO COLLECTING**

Collect, organise and evaluate information. Note: The ability of the learner to collect information on refuge chambers at specified locations will indicate proficiency in collecting, organising and evaluating information.

#### **UNIT STANDARD CCFO COMMUNICATING**

Communicate effectively using visual, mathematics and language skills in the modes of oral and written presentations. Note: The ability of the learner to communicate problems concerning refuge chambers will indicate his/her effectiveness to communicate information.

#### **UNIT STANDARD CCFO SCIENCE**

Use science and technology effectively and critically (showing responsibility towards the environment and health of others). Note: The ability of the learner to select the appropriate equipment and procedure indicates that he/she is able to use science and technology.

#### **UNIT STANDARD ASSESSOR CRITERIA**

Assessors should keep the following principles in mind when designing and conducting assessments against this unit standard:

- Focus the assessment activities on gathering evidence in terms of the main outcome expressed in the title to ensure assessment is integrated rather than fragmented. Remember we want to declare the learner competent in terms of the title. Where assessment at title level is unmanageable, then focus assessment around each specific outcome, or groups of specific outcomes.
- Make sure evidence is gathered across the entire range, wherever it applies. Assessment activities should be as close to the real performance as possible, and where simulations or role-plays are used, there should be supporting evidence to show the learner is able to perform in the real situation.
- Do not focus the assessment activities on each assessment criterion. Rather make sure the assessment activities focus on outcomes and are sufficient to enable evidence to be gathered around all the assessment criteria.
- The assessment criteria provide the specifications against which assessment judgements should be made. In most cases, knowledge can be inferred from the quality of the performances, but in other cases, knowledge and understanding will have to be tested through questioning techniques. Where this is required, there will be assessment criteria to specify the standard required.
- The task of the assessor is to gather sufficient evidence, of the prescribed type and quality, as specified in this unit standard, that the learner can achieve the outcomes again and again and again. This means assessors will have to judge how many repeat performances are required before they believe the performance is reproducible.
- All assessments should be conducted in line with the following well documented principles of assessment: appropriateness, fairness, manageability, integration into work or learning, validity, direct, authentic, sufficient, systematic, open and consistent.

#### **UNIT STANDARD NOTES**

Specified requirements include legal and site-specific requirements and are contained in one or more of the following documents:

Legal requirements:

- OHS Act and Regulations 85 / 1993
- Mine Health and Safety Act and Regulations 29/1996
- Guideline for mandatory Codes of Practice

Site-specific requirements:

- Managerial instructions
- Codes of Practice
- Company Standards
- Standard Task Procedures
- Health Management Programme
- Risk Assessment Documentation

- Working Guides
- Manufacturers` specifications

**QUALIFICATIONS UTILIZING THIS UNIT STANDARD:**

	<b>ID</b>	<b>QUALIFICATION TITLE</b>	<b>LEVEL</b>	<b>STATUS</b>	<b>END DATE</b>
Elective	<a href="#">48804</a>	National Certificate: Occupational Safety, Hygiene and Environment	Level 2	Reregistered	2010-08-07

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# APPENDIX H: UNIT STANDARD FOR NATIONAL CERTIFICATE IN OHS&E



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## SOUTH AFRICAN QUALIFICATIONS AUTHORITY REGISTERED QUALIFICATION:

### National Certificate: Occupational Safety, Hygiene and Environment

SAQA QUAL ID	QUALIFICATION TITLE			
48804	National Certificate: Occupational Safety, Hygiene and Environment			
SGB NAME		REGISTERING PROVIDER		
SGB Occupational Health and Safety				
Quality Assuring ETQA				
HW SETA-Health and Welfare Sector Education and Training Authority				
QUALIFICATION TYPE	FIELD	SUBFIELD		
National Certificate	Field 09 - Health Sciences and Social Services	Preventive Health		
ABET BAND	MINIMUM CREDITS	NQF LEVEL	QUAL CLASS	
Undefined	135	Level 2	Regular-Unit Stds Based	
REGISTRATION STATUS	SAQA NUMBER	DECISION	REGISTRATION START DATE	REGISTRATION END DATE
Reregistered	SAQA 0160/05		2007-08-07	2010-08-07

### PURPOSE AND RATIONALE OF THE QUALIFICATION

This qualification enables learners to identify and evaluate occupational safety, hygiene and environmental factors, in occupational environments, which may have a detrimental effect on the health and safety of learners in such environments. Learners credited with this qualification are able to perform essential measurements and functions that promote a culture of health and safety in occupational environments. The qualification is designed to be flexible and accessible.

Learners credited with this qualification are capable of:

- Communicating effectively using visual, mathematic and language skills in the modes of oral and written presentation
- Solving mathematics problems related to finances, patterns, statistics, shape and motion using numbers and number systems
- Describing concepts and principles in science and the natural environment
- Operating personal computers and computer systems
- Collecting, analyzing, organizing and critically evaluating information about occupational hygiene, safety and environmental conditions and elements using science and technology effectively and critically to measure them
- Identifying and solving problems to make responsible decisions regarding workplace hazards and risks
- Ensuring safe, healthy workplace environments and conduct
- Working effectively with others as a member of a team, group, organization or community to attain generic occupational, as well as specialized occupational safety or hygiene or environment operational competence

#### Rationale:

Learners credited with this qualification are likely to be working in the occupational safety, hygiene and environmental disciplines. For attainment of the Unit Standards, learners are required to integrate practical skills with essential knowledge, and to obtain the qualification they are required to integrate the competencies credited in the Unit Standards that the qualification is based on.

In South Africa and internationally, the social and economic impact of occupational safety, hygiene, health, and environment is great. Direct costs that result from poor workplace safety, hygiene, health, and environments include human and economic costs. Indirect costs are also incurred and can include poor morale, poor productivity, downtime, etc. Improved workplace safety, hygiene, health, and environments could influence the South African economy in direct costs alone to the value of millions of Rands each year. This qualification aims to meet the demand for learners that are able to facilitate a safe, healthy and productive occupational environment.

There is a critical need in the industry to recognize learner competence regarding essential operations associated with a healthy, safe and productive working environment. This qualification is the entry level to a career path in one of the areas of specialization in Occupational Safety, Hygiene and Environment (SHE). It is generic enough to allow maximum mobility within the field of application. Skills, knowledge, values and attitudes (competencies) reflected in the qualification are building blocks towards a level 4 qualification.

#### **LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING**

This qualification was designed based on the assumption that learners embarking on learning towards this qualification have already attained the language, communication, and mathematic literacy competencies required at NQF Level 1, including that they are able to:

- Engage in a range of speaking and listening interactions for a variety of purposes
- Explore and use a variety of strategies to learn
- Identify and respond to selected literary texts
- Read and respond to a range of text types
- Write for a variety of different purposes analyse cultural products and processes as representations of shape, space and time
- Collect, analyse, use and communicate numerical data
- Critically analyse how mathematics is used in social, political and economic relations
- Demonstrate an understanding of and use the numbering system
- Describe and represent objects and the environment in terms of shape, space, time and motion
- Describe, represent and interpret mathematic models in different contexts
- Use algebraic notation, conventions and terminology to solve problems
- Use maps to access and communicate information concerning routes, location and direction
- Work with measurement in a variety of contexts
- Work with patterns in various contexts
- Working with numbers in various contexts

#### Recognition of Prior Learning (RPL):

This qualification can be achieved wholly, or in part, through recognition of prior learning. Evidence can be presented in a variety of forms, including previous international or local qualifications, reports, testimonials, mentoring, functions performed, portfolios, work records and performance records. As such, evidence should be judged according to the general principles of assessment described in the notes to assessors below. Learners who have met the requirements of any Unit Standard that forms part of this qualification may apply for recognition of prior learning to the relevant Education and Training Quality Assurance body (ETQA). The applicant must be assessed against the specific outcomes and with the assessment criteria for the relevant Unit Standards. A qualification will be awarded should a learner demonstrate that the exit level outcomes of the qualification have been attained.

#### **RECOGNISE PREVIOUS LEARNING?**

Yes

#### **QUALIFICATION RULES**

All Fundamental component Unit Standards are compulsory (52 credits must be attained):

- 20 credits for Communication and Language
- 16 credits for Mathematic Literacy

- 7 credits for Natural Sciences
- 9 credits for Computer Literacy

All Core component Unit Standards are compulsory (70 credits must be attained).

The Elective Component consists of a number of unit standards from which at least 13 credits must be attained.

### **EXIT LEVEL OUTCOMES**

1. Communicate effectively using visual, mathematic and language skills in the modes of oral and written presentation.
2. Solve mathematic problems related to finances, patterns, statistics, shape and motion using numbers and number systems.
3. Describe concepts and principles in science and the natural environment.
4. Operate personal computers and computer systems.
5. Collect, analyze, organize and critically evaluate information about occupational hygiene, safety and environmental conditions and elements using science and technology effectively and critically to measure them. Range: Measurement of mass, pressure, noise levels, air velocity, volume flow rate, illumination levels, environmental thermal conditions, impact of industrial processes on environmental receptors, ventilation, gases etc. are included.
6. Identify and solve problems to make responsible decisions regarding workplace hazards and risks. Range: Risks include sexually transmitted diseases such as HIV/AIDS.
7. Ensure safe, healthy workplace environments and conduct. Range: Qualifying learners are required to take responsibility for their own conduct.
8. Work effectively with others as a member of a team, group, organization or community to attain generic occupational, as well as specialized occupational safety, hygiene, environment OR occupational medicine operational competence.

### **ASSOCIATED ASSESSMENT CRITERIA**

1.
  - Information from texts is accessed and used appropriately and effectively for specific contexts
  - Oral communication is maintained and adapted according to specific contexts
  - Writing is appropriate for defined contexts
2.
  - Related problems are solved using patterns and basic mathematic functions
  - Life and work related problems are investigated using relevant statistics
  - Rational and irrational numbers and number systems are used effectively
  - Shape and motion in 2- and 3-dimensional space are describe and represented accurately
  - Financial aspects of personal and community life are investigated and monitored effectively for specified contexts
3.
  - The concept of science is described correctly
  - Fundamental concepts and principles in the natural sciences are described correctly
  - Human systems are accurately described
  - The relationship between society and the natural environment is accurately described
4.
  - Personal computer systems and operating systems are used effectively for specified contexts
  - Personal computer systems and operating systems are used correctly
  - Use of personal computer systems and operating systems meet security requirements
5.
  - Identification and description of occupational hygiene, safety and environmental conditions and elements are accurate
  - Relevant principles of measurement are accurately identified and described

- Measurements are accurate
- Measurements selected are appropriate for specified contexts
- Instruments and technologies selected for measurement are appropriate for specified contexts and purposes
- Relevant legal and other context-specific requirements are adhered to

6.

- Occupational safety, hygiene and environment principles are accurately described
- Workplace hazards and risks are accurately identified
- Workplace hazards and risks are addressed according to specified procedures and requirements
- Workplace hazards and risks are recorded according to specified recording procedures
- Workplace hazards and risks are reported according to specified reporting procedures
- Corrective and/or mitigation measures are taken where necessary
- Corrective and/or mitigation measures are appropriate for specified context

7.

- Workplace safety, health and environmental principles and procedures are accurately described
- Workplace safety, health and environmental requirements are adhered to at all times
- Personal protective and monitoring equipment is used correctly and when appropriate

8.

- Workplace safety and health requirements are adhered to
- Principles of safety, hygiene and environment management are adhered to
- Analysis is accurate (Range: Analysis of, for example, dust samples, life sustainability of refuge chambers, etc. is included)
- Inspections meet specified requirements (Range: Inspections include, for example, inspection of percussion rock drills, and safety inspections)
- Sampling and measurements are accurate and meet specified requirements (Range: Sampling and measurement of, for example, water content, temperature, radioactive contamination, radiation, cooling power, low air velocities, air, water and barometric pressure, thermal conditions, personal equivalent noise exposure levels, environmental pollution, etc.)
- Primary emergency care requirements are met (Range: Dealing with wounds, fractures, thermal conditions, reporting to the compensation commissioner, etc.)

#### Integrated Assessment:

Learners may be credited for individual unit standards when they meet the requirements of each unit standard. For award of the qualification, a learner must achieve all core and fundamental Unit Standards, and at least 13 credits from any of the elective Unit Standards. The assessment criteria in the Unit Standards are performance-based, assessing applied competence rather than only knowledge, or skills. In addition, learners must demonstrate that they can achieve the outcomes in an integrated manner, dealing effectively with different and random demands related to the environmental conditions in occupational contexts, to qualify. Evidence is required that the learner is able to achieve the exit level outcomes of the qualification as a whole and thus its purpose, at the time of the award of the qualification. Workplace experience can be recognised when assessing towards this qualification.

#### **INTERNATIONAL COMPARABILITY**

This qualification and component Unit Standards for this qualification have been compared with other countries. The qualification does not exist at the equivalent level on frameworks in New Zealand, United Kingdom, and Australia. However, the design of the qualification addresses equivalent areas of competence.

On the Australian framework, occupational health, safety and environment qualifications fall within the Vocational Education and Training sector, which recognises skills and knowledge that meet nationally endorsed industry/enterprise competency standards as agreed for those qualifications by the relevant industry, enterprise, community or professional group. The available qualifications also include literacy and numeracy, communication, working in teams (critical cross field outcome on the South African NQF), workplace technology, and industry specific competencies. Various programs are available, including a Certificate III in Occupational Health and Safety, Certificate IV in Auditing Occupational Health and Safety Systems, Certificate IV in Occupational Health and Safety, and a Diploma of Occupational Health and Safety. Certificate III is year 12, or equivalent to the South African NQF Level 4.

In the United Kingdom, no equivalent for the South African NQF Level 2 qualification exists. A Foundation certificate in Health and safety in a workplace is available, within the Hospitality sector. In addition, National Vocational Qualifications exist for Security, Safety and Loss Prevention at Level 2, Occupational Health and Safety



at Level 3 (Grade 12 or NQF Level 4 equivalent in South Africa), Occupational Health and Safety Practice at Levels 4 and 5 and Health and Safety Regulation at Level 5. Other than these, health, safety and environmental issues are integrated within most other relevant qualifications, such as general science (equivalent to NQF Level 1 in South Africa), design, and engineering. In Scotland, two Vocational qualifications are provided, namely, Occupational Health and Safety Practice at Level 3, and Occupational Health and Safety Practice at Level 4.

The New Zealand NQF places occupational health and safety within the fields of Health, Manufacturing (Dairy Workplace Health and Safety) and Planning and Construction (Construction Health and Safety and Injury Prevention). The South African equivalent is in the field of Health, specifically Occupational Health and Safety. The South African NQF Level 4 is the equivalent of the New Zealand NQF Level 3. Two qualifications are registered in the field of Health, on the New Zealand NQF, namely, a National Certificate in Occupational Health and Safety (Co-ordination) (Level 4), and a National Certificate in Occupational Health and Safety (Workplace Safety) (Level 3).

Unit standards on the New Zealand NQF are all at a higher level than this qualification, and include the following:

- Protect health and safety in a workplace (Level 1, Credits 1)
- Assist in evaluating occupational health and safety standards and practice (Level 4, Credits 15)
- Assist in hazard identification and control for occupational health and safety practice (Level 4, Credits 10)
- Demonstrate knowledge of health and safety management requirements for contractors working on site (Level 4, Credits 8)
- Explain the establishment and operation of a workplace health and safety committee (Level 4, Credits 5)
- Explain the requirements of the health and safety in employment act (HSE) 1992 (Level 4, Credits 2)
- Maintain standards of practice in an occupational health and safety practice (Level 5, Credits 5)
- Develop and implement workplace occupational health and safety policy and standards (Level 5, Credits 10)
- Develop systems for occupational health and safety management practice (Level 6, Credits 20)
- Evaluate occupational health and safety standards and practice (Level 6, Credits 30)
- Facilitate hazard management in an occupational health and safety practice (Level 6, Credits 30)
- Plan and evaluate programmes to promote occupational health and safety practice (Level 6, Credits 20)
- Implement workplace health and safety management requirements (Level 4, Credits 25)
- Manage workplace management health and safety (Level 5, Credits 10)

#### **ARTICULATION OPTIONS**

This qualification can provide access to learners to progress to higher-level qualifications in the discipline of Occupational Safety, Hygiene and Environment, and in various industrial sectors and related sub-fields. Most qualifications on the NQF require competence regarding this discipline, and thus provide an access point to, for example qualifications in the Physical Planning and Construction field, the Manufacturing, Engineering and Technology field, the Business, Commerce and Management Field, etc.

The qualification, through the fundamental component for communication and mathematic literacy, articulates horizontally with all NQF registered qualifications at NQF Level 2, and vertically up and down with NQF Levels 1 and 3. In addition, Fundamental Unit Standards relating to Natural Sciences and Computer Literacy form part of many other NQF qualifications.

#### **MODERATION OPTIONS**

Moderation of assessment and accreditation of providers shall be at the discretion of a relevant ETQA as long as it complies with the SAQA requirements. The ETQA is responsible for moderation of learner achievements of learners who meet the requirements of this qualification. Particular moderation and accreditation requirements are:

- Any institution offering learning that will enable the achievement of this qualification must be accredited as a provider with the relevant ETQA. Providers offering learning towards achievement of any of the Unit Standards that make up this qualification must also be accredited through the relevant ETQA accredited by SAQA.
- The ETQA will oversee assessment and moderation of assessment according to their policies and guidelines for assessment and moderation, or in terms of agreements reached around assessment and moderation between the relevant ETQA and other ETQAs and in terms of the moderation guideline detailed here.
- Moderation must include both internal and external moderation of assessments for the qualification, unless the relevant ETQA policies specify otherwise. Moderation should also encompass achievement of the competence described in Unit Standards as well as the integrated competence described in the qualification.

- Internal moderation of assessment must take place at the point of assessment with external moderation provided by a relevant ETQA according to the moderation guidelines and the agreed ETQA procedures.
- Anyone wishing to be assessed against this qualification may apply to be assessed by any assessment agency, assessor or provider institution that is accredited by the relevant ETQA.

### **CRITERIA FOR THE REGISTRATION OF ASSESSORS**

Assessment of learner achievements takes place at providers accredited by the relevant ETQA (RSA, 1998b) for the provision of programmes that result in the outcomes specified for the National Certificate in Occupational Safety, Hygiene and Environment (NQF Level 2). Anyone assessing a learner or moderating the assessment of a learner against this qualification must be registered as an assessor with the ETQA. Assessors registered with the relevant ETQA must carry out the assessment of learners for the qualification and any of the Unit Standards that make up this qualification.

To register as an assessor, the following are required:

- Detailed documentary proof of relevant qualification/s, practical training completed, and experience gained (a Portfolio of Evidence)
- NQF recognised assessor credits.

Assessors should keep the following general principles in mind when designing and conducting assessments:

- Focus the initial assessment activities on gathering evidence in terms of the main outcomes expressed in the titles of the Unit Standards to ensure assessment is integrated rather than fragmented. Remember that the learner needs to be declared competent in terms of the qualification purpose and exit level outcomes.
- Where assessment across Unit Standard titles or at Unit Standard title level is unmanageable, then focus assessment around each specific outcome, or groups of specific outcomes. Take special note of the need for integrated assessment.
- Make sure evidence is gathered across the entire range, wherever it applies.

In particular, assessors should assess that the learner demonstrates an ability to consider a range of options by:

- Measuring the quality of the observed practical performance as well as the theory and underpinning knowledge.
- Using methods that are varied to allow the learner to display thinking and decision making in the demonstration of practical performance.
- Maintaining a balance between practical performance and theoretical assessment methods to ensure each is measured in accordance with the level of the qualification.
- Taking into account that the relationship between practical and theoretical components is not fixed, but varies according to the type and level of qualification.

All assessments should be conducted in line with the following well-documented principles:

- **Appropriate:** The method of assessment is suited to the performance being assessed.
- **Fair:** The method of assessment does not present any barriers to achievements, which are not related to the evidence.
- **Manage:** The methods used make for easily arranged cost-effective assessments that do not unduly interfere with learning.
- **Integrate into work or learning:** Evidence collection is integrated into the work or learning process where this is appropriate and feasible.
- **Valid:** The assessment focuses on the requirements laid down in the standards; i.e. the assessment is fit for purpose.

- Direct: The activities in the assessment mirror the conditions of actual performance as close as possible.
- Authentic: The assessor is satisfied that the work being assessed is attributable to the learner being assessed.
- Sufficient: The evidence collected establishes that all criteria have been met and that performance to the required Standard can be repeated consistently.
- Systematic: Planning and recording is sufficiently rigorous to ensure that assessment is fair.
- Open: Learners can contribute to the planning and accumulation of evidence. Learners for assessment understand the assessment process and the criteria that apply.
- Consistent: The same assessor would make the same judgement again in similar circumstances. The judgement made is similar than the judgement that would be made by other assessors.

#### NOTES

N/A

#### UNIT STANDARDS:

	ID	UNIT STANDARD TITLE	LEVEL	CREDITS
Core	<a href="#">110075</a>	Apply basic fire fighting techniques	Level 1	3
Core	<a href="#">14656</a>	Demonstrate an understanding of sexuality and sexually transmitted infections including HIV/AIDS	Level 1	5
Core	<a href="#">116527</a>	Demonstrate knowledge pertaining to basic health and safety principles in and around a workplace	Level 1	2
Core	<a href="#">115096</a>	Issue and retrieve personal monitoring equipment	Level 1	1
Core	<a href="#">7489</a>	Show, explain, discuss and analyse the relationship between society and natural environment	Level 1	4
Core	<a href="#">115101</a>	Address workplace hazards and risks	Level 2	4
Core	<a href="#">116520</a>	Apply safety, health and environmental principles and procedures in a workplace	Level 2	2
Core	<a href="#">115087</a>	Conduct a preliminary incident investigation into workplace health, safety and environmental incidents	Level 2	2
Core	<a href="#">116518</a>	Conduct safety and health representation activities	Level 2	3
Core	<a href="#">116533</a>	Demonstrate basic knowledge and understanding of emergency preparedness and response	Level 2	2
Core	<a href="#">115105</a>	Determine wet and dry bulb temperature by means of a whirling hygrometer and take appropriate action	Level 2	2
Core	<a href="#">115102</a>	Identify, locate and record environmental elements using a geographical positioning system (GPS)	Level 2	2
Core	<a href="#">115092</a>	Measure and record the concentration of flammable and noxious gases and vapours and take appropriate action	Level 2	2
Core	<a href="#">115091</a>	Monitor compliance to safety, health and environmental requirements in a workplace	Level 2	2
Core	<a href="#">119355</a>	Participate in the development, implementation and evaluation of a safety, health and environmental management programme in the workplace	Level 2	2
Core	<a href="#">115097</a>	Participate in the establishment, implementation and monitoring of a health and safety agreement	Level 2	2
Core	<a href="#">115099</a>	Plan sampling and analysis	Level 2	2
Core	<a href="#">116534</a>	Carry out basic first aid treatment in the workplace	Level 3	2
Core	<a href="#">115093</a>	Control workplace hazardous substances	Level 3	4
Core	<a href="#">116523</a>	Demonstrate knowledge of basic occupational hygiene principles	Level 3	2

Core	<a href="#">115109</a>	Grade the potential of specified industrial processes to impact on environmental receptors	Level 3	5
Core	<a href="#">116524</a>	Measure environmental factors and take appropriate action	Level 3	15
Fundamental	<a href="#">14110</a>	Demonstrate an understanding of fundamental concepts and principles in the natural sciences	Level 1	5
Fundamental	<a href="#">7507</a>	Demonstrate an understanding of the concept of science	Level 1	2
Fundamental	<a href="#">8963</a>	Access and use information from texts	Level 2	5
Fundamental	<a href="#">9009</a>	Apply basic knowledge of statistics and probability to influence the use of data and procedures in order to investigate life related problems	Level 2	3
Fundamental	<a href="#">7480</a>	Demonstrate understanding of rational and irrational numbers and number systems	Level 2	3
Fundamental	<a href="#">9008</a>	Identify, describe, compare, classify, explore shape and motion in 2-and 3-dimensional shapes in different contexts	Level 2	3
Fundamental	<a href="#">8962</a>	Maintain and adapt oral communication	Level 2	5
Fundamental	<a href="#">7547</a>	Operate a personal computer system	Level 2	6
Fundamental	<a href="#">8967</a>	Use language and communication in occupational learning programmes	Level 2	5
Fundamental	<a href="#">7469</a>	Use mathematics to investigate and monitor the financial aspects of personal and community life	Level 2	2
Fundamental	<a href="#">7548</a>	Use personal computer operating system	Level 2	3
Fundamental	<a href="#">9007</a>	Work with a range of patterns and functions and solve problems	Level 2	5
Fundamental	<a href="#">8964</a>	Write for a defined context	Level 2	5
Elective	<a href="#">116509</a>	Apply primary emergency life support	Level 1	2
Elective	<a href="#">116511</a>	Carry out basic first aid treatment in the workplace	Level 1	1
Elective	<a href="#">119568</a>	Demonstrate basic occupational health and knowledge pertaining to the principles of handling of materials in a workplace	Level 1	1
Elective	<a href="#">116508</a>	Demonstrate basic understanding of the procedure for compensation claims submissions for occupational injuries and diseases	Level 1	2
Elective	<a href="#">116516</a>	Apply stone dust to inertise coal dust	Level 2	2
Elective	<a href="#">115107</a>	Collect water sample for analysis	Level 2	2
Elective	<a href="#">116503</a>	Completion of Compensation Commissioner documentation for Occupational Injuries and Diseases	Level 2	3
Elective	<a href="#">116517</a>	Conduct routine inspections on percussion rock drills	Level 2	2
Elective	<a href="#">116513</a>	Examine refuge chambers to ensure they are life sustainable	Level 2	1
Elective	<a href="#">116507</a>	Explain the functional aspects of the human anatomy in the use of primary emergency care terminology	Level 2	1
Elective	<a href="#">115090</a>	Install explosion barriers to control the propagation of coal dust explosions	Level 2	2
Elective	<a href="#">115094</a>	Measure and record pressures and take appropriate action	Level 2	2
Elective	<a href="#">115089</a>	Measure virgin rock temperature	Level 2	2
Elective	<a href="#">116505</a>	Perform a vision-screening test in the working place	Level 2	2
Elective	<a href="#">115103</a>	Sample and evaluate a mixture of coal dust and stone dust	Level 2	3

Elective	<a href="#">116498</a>	Analyse absenteeism related to occupational health/medical related conditions in the work place	Level 3	4
Elective	<a href="#">116501</a>	Demonstrate the interpretation of vital signs when providing primary emergency care or first aid	Level 3	1
Elective	<a href="#">116515</a>	Determine the amount of rock dust and particulate matter in water	Level 3	4
Elective	<a href="#">116499</a>	Perform vital signs in the working place	Level 3	6
Elective	<a href="#">116496</a>	Provide primary emergency care for bleeding and wounds	Level 3	1
Elective	<a href="#">116500</a>	Provide primary emergency life support for fractures and dislocations	Level 3	1
Elective	<a href="#">116497</a>	Provision of primary emergency care intervention for shock, unconsciousness and fainting in the working place	Level 3	1

**LEARNING PROGRAMMES RECORDED AGAINST THIS QUALIFICATION:  
NONE**

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## APPENDIX I: MSHA ACT REGULATIONS

- 17.2 The employer must engage the part-time or full services of a competent person to be in charge of surveying, mapping and mine plans at the mine, and if the services of more than one competent person are engaged, ensure that their functions do not overlap.
- 17.5(a) working which are being advanced;
- 17.5(e) safety pillars that are being, or have been, removed.
- 17.9 The employer must take reasonable measures to ensure that the relevant survey records and plans resulting from conditions described in regulation 17.5[a] and 17.5[e] are updated by the competent person referred to in regulation 17.2 at intervals not exceeding three months.

## **APPENDIX J: MINE HEALTH AND SAFETY ACT, 1996 CHAPTER 4, SECTION 10 - EMPLOYER TO PROVIDE HEALTH AND SAFETY TRAINING**

- 1) As far as reasonably practicable, every employer must--
  - a) provide employees with any information, instruction, training or supervision that is necessary to enable them to perform their work safely and without risk to health; and
  - b) ensure that every employee becomes familiar with work-related hazards and risks and the measures that must be taken to eliminate, control and minimize those hazards and risks.  
*(Employees must not be made to pay for health and safety training. See section 24.)*
  
- 2) As far as reasonably practicable, every employer must ensure that every employee is properly trained--
  - a) to deal with every risk to the employee's health or safety that--
    - i) is associated with any work that the employee has to perform, and
    - ii) has been recorded in terms of section 11;
  - b) in the measures necessary to eliminate, control and minimize those risks to health or safety;
  - c) in the procedures to be followed to perform that employee's work; and
  - d) in relevant emergency procedures.
  
- 3) In respect of every employee, the provisions of subsection (2) must be complied with--
  - a) before that employee first starts work;
  - b) at intervals determined by the employer after consulting the health and safety committee;
  - c) before significant changes are introduced to procedures, mining and ventilation layouts, mining methods, plant or equipment and material; and
  - d) before significant changes are made to the nature of that employee's occupation or work.

## APPENDIX K: LAUNCH OF AWARENESS TRAINING PROGRAMME FOR ANGLO COAL AT CSIR KLOPPERSBOS FACILITY

A mine explosion and fire awareness training programme developed specifically for Anglo Coal underground personnel was re-launched at the CSIRs Kloppersbos facility yesterday. The event, which included a number of explosion demonstrations, was attended by a number of Anglo Coal representatives, as well as officials from the Department of Minerals and Energy (DME).

Originally initiated in 2002, the programme has been updated and modified to include fire awareness training (in addition to the training on methane and coal dust explosions offered in the original course). The programme will kick off in July 2006 with weekly training sessions, limited to 40 individuals per session.

According to Karel van Dyk, Manager: Explosion Testing and Fire Management at CSIR Knowledge Services, the purpose of the programme is to increase awareness of the risk presented by fire and explosions in the underground environment. In particular, the programme aims to familiarize Anglo Coal personnel with a number of key issues, including:

- the importance of mine ventilation
- strategies for preventing coal mine explosions
- possible ignition sources for fires and explosions
- how different explosion barriers operate

During his welcoming address, Van Dyk pointed out that the course was an important part of the CSIRs contribution to an improved safety record in the coal mining industry. He emphasized that Anglo Coal had pioneered the idea of a tailor-made course dedicated to the training needs of their underground personnel. He also acknowledged the DMEs support for the programme.

### Contact details

[Deidre Lotter](#)

E-mail: [dlotter@csir.co.za](mailto:dlotter@csir.co.za)

Tel: +27 128413926





# APPENDIX L: EXAMPLE OF EARLY COLLAPSIBLE REFUGE CHAMBER

## BROSEAL REFUGE CHAMBERS

for breathing space in emergency situations










*Typical 12 man unit folded for transport*





Broseal's versatile refuge chambers\* are 100% reclaimable, easily erected and fully equipped.

The rust resistant, fire proof units are readily transportable due to their unique collapsable design (see diagram). Broseal refuge chambers are suitable for all types of underground mining and may be joined together to provide accommodation for any number of people.

All in all, Broseal Refuge Chambers offer distinct advantages over more conventional means. Full technical details are available on request.

\*Patent Pending



## Broseal Ventilation

A Member of the Murray & Roberts Group 

BROSEAL VENTILATION (PTY) LTD  
 Co. Reg. No. 57/03342/07  
 P.O. Box 160  
 Krugersdorp 1740  
 Tel: (011) 664-8070  
 Fax: (011) 664-4322

1 Resnick Street  
 Factory  
 Krugersdorp  
 Telex: 4-20834SA

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