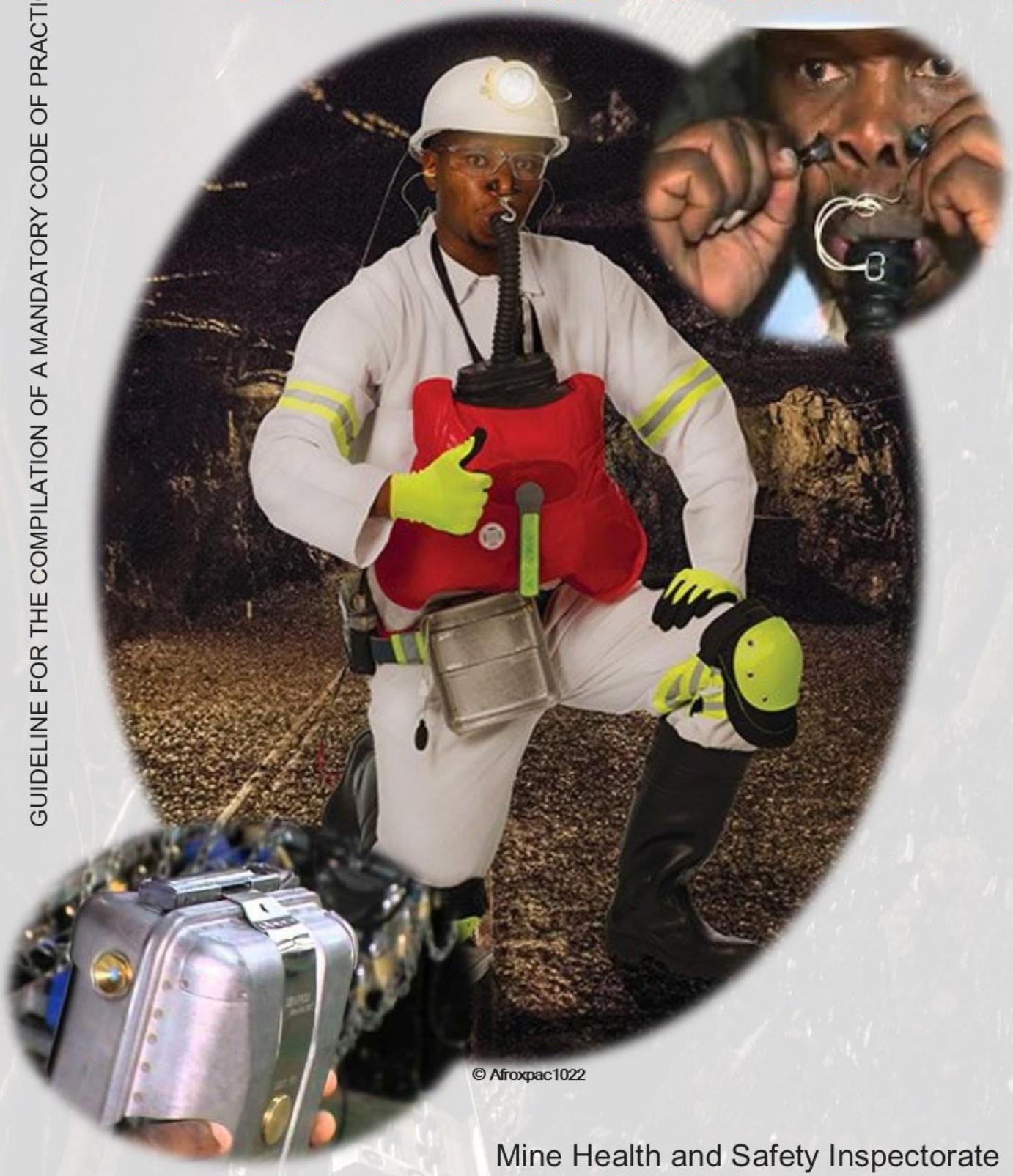
GUIDELINE FOR THE COMPILATION OF A MANDATORY CODE OF PRACTICE FOR THE

MANAGEMENT OF SELF-CONTAINED SELF-RESCUERS IN MINES



Mine Health and Safety Inspectorate

mineral resources
Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

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DEPARTMENT OF MINERAL RESOURCES

MINE HEALTH AND SAFETY INSPECTORATE

GUIDELINE FOR THE COMPILATION OF A

MANDATORY CODE OF PRACTICE FOR

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CHIEF INSPECTOR OF MINES

mineral resources
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PART A: THE GUIDELINE

1. FOREWORD

The guideline for the management of **SCSRs** has been developed to detail relevant requirements of applicable sections of the Chapter 16 Regulations of the **MHSA** relating to responses to emergencies in mines.

1.1. The mining industry has seen the occurrence of low frequency, major impact, unwanted events resulting in numerous fatalities, injuries and considerable damage to the mine's infrastructure. Gas explosions, the ignition of flammable dust clouds and underground fires are examples of events that result in emergencies where **employees** must evacuate a mine while being exposed to **irrespirable atmospheres** resulting from such events.

1.2. Entrenched in the intent of the **MHSA**, are efforts that should be directed primarily at avoiding the occurrence of such unwanted events through risk elimination and risk mitigation. Only when such measures do not yield acceptable residual risk levels, shall other methods be employed that will ensure that the safety of **employees** in the aftermath of such events is assured.

1.3. In the case where irrespirable atmospheres may occur, the use of **SCSRs** should be considered as a mitigating measure. Chapter 16.2 of the **MHSA** Regulations provides clear guidance as to which classes of mines or instances where the use of self-contained self-rescuers is deemed mandatory.

2. LEGAL STATUS OF GUIDELINES AND COPs

2.1. In accordance with section 9(2) of the **MHSA** an employer must 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 mines if the **CIOM** requires it. These **COPs** must comply with any relevant guideline issued by the **CIOM** (section 9(3)). Failure by the employer to prepare or implement a **COP** in compliance with this guideline is a breach of the **MHSA**.

2.2. This guideline provides a framework to assist employers to implement principles required for the management of procedures intended for the appropriate **deployment** of **SCSRs** in mines.

3. THE OBJECTIVE OF THIS GUIDELINE

3.1. The objective of this guideline is to provide guidance in compiling a mandatory **COP** to the employer of every mine where **SCSRs** must be deployed, developed within the context of Chapter 16 of the **MHSA** Regulations. It is intended that, if properly structured and strictly implemented, the **COP** shall assist the employer to manage all aspects associated with the deployment of **SCSRs** and shall ensure that the life-saving potential of these units is realised thereby minimising risks to persons affected by emergencies where **irrespirable atmospheres** are encountered.

3.2. The guideline provides guidance on the required format and content for the **COP** and details sufficient technical background to enable a drafting committee at the mine to prepare a comprehensive and practical **COP** for their mine.

4. DEFINITIONS AND ACRONYMS

4.1. In this guideline, or any amendment thereof, unless otherwise indicated, the following definitions and acronyms are applicable:

a) **"ATA"** means an Accredited Testing Authority, an organisation accredited to test **SCSRs** in terms of the South African National Accreditation System, for the assessment of the structural integrity and functional performance of **SCSRs**.

b) **"Body-worn self-contained self-rescuer" (BWSCSR)** means a **SCSR** designed to be worn by workers on their body for the duration of a complete underground working shift that will allow workers to reach a **place of safety** in an **emergency**.

c) "**CIOM**" means Chief Inspector of Mines.

d) **"COP"** means Code of Practice.

e) **"Cold start"** means **SCSR** activation for units not equipped with oxygen starters.

f) **"CSIR"** means Council for Scientific and Industrial Research.

g) **"Deployment"** (of **SCSR**) is a process by which **SCSRs** are issued individually to **employees**, contractors or **visitors** to a mine or section of a mine where, through the application of Regulation 16.2 of the **MHSA**, **employees** must be equipped with **SCSRs** when proceeding underground.

h) **"DMR"** means Department of Mineral Resources.

i) **"Donning"** (of **SCSR**) is the procedure followed by a person to activate their **SCSR** as required by mine **emergency** procedures.

j) **"Emergency"** means a situation, event or set of circumstances at a mine that could threaten the health or safety of persons at the mine, and which requires immediate remedial action, such as the evacuation, rescue or recovery of persons, to prevent serious injury or harm, or further serious injury or harm, to persons.

k) **"Employees"** means, for the purpose of this guideline, **employees** as defined in the **MHSA** and any other person who is required to wear a **SCSR** while at a mine.

l) **"Irrespirable atmosphere"** means an atmosphere in a mine, requiring **employees** to wear breathing apparatus or **SCSRs** due to the presence of poisonous gas or insufficient oxygen caused by an incident at the mine e.g. as a result of but not limited to combustible gas explosions, coal-dust explosions, combined gas and dust explosions, or mine fires.

m) **"Long duration self-contained self-rescuer (LDSCSR)** means a **SCSR** that will supply oxygen for a minimum of 50 minutes at a ventilation rate of 35 litres per minute. The unit must provide oxygen instantly when activated, e.g. by chemical

reaction or compressed oxygen starters, that may be used to escape from a **place of safety** to surface.

n) **"MHSA"** means the Mine Health and Safety Act, 1996 (Act 29 of 1996), as amended.

o) **"MHSC"** means Mine Health and Safety Council.

p) **"MHSI"** means Mine Health and Safety Inspectorate.

q) **"MRS"** means Mines Rescue Services.

r) **"OEM"** means original equipment manufacturer.

s) **"Place of safety"** means any place, which, during an **emergency**, can sustain life for the duration of the **emergency** and is adequate in size and capacity to accommodate the maximum number of affected persons likely to be present in the area served by it.

t) **"SANS 1737"** means South African National Standard for body-worn escape type breathing apparatus.

u) **"Self-contained self-rescuer (SCSR)"** means a portable oxygen source (chemical or stored) that, when activated, will provide breathable air in a closed circuit.

v) **"SIMRAC"** means Safety in Mines Research Advisory Committee.

w) **"Visitor"** means a person, other than an employee, who is expected to spend one shift or less in an area of the mine that requires the **deployment** of **SCSRs**.

5. SCOPE

5.1. In structuring the mine's **COP** for the management of **SCSRs,** this guideline shall be used in conjunction with the guideline for the compilation of a mandatory **COP** for **Emergency** Preparedness and Response which it is intended to complement.

5.2. The scope of the **COP** for the management of all **SCSRs** in mines under the control of the employer (excluding units under the control of the mines rescue service providers) includes:

5.2.1. Details for the allocation, use, testing and maintenance of **SCSRs** in accordance with Chapter 16 of the **MHSA** Regulations.

5.2.2. Procedures for:

5.2.2.1. The procurement, storage, maintenance, allocation, use and disposal of **SCSRs** at a mine;

5.2.2.2. The execution and enhancement of incident investigations involving **SCSRs**; and

5.2.2.3. Training of **employees** in the **deployment**, activation and use of **SCSRs.**

5.3. Adoption of relevant additional information, as required, from reputable sources on all aspects related to the **deployment** of **SCSRs** e.g. **SIMRAC** Research Reports, **CSIR**, South African Bureau of Standards, etc.

6. MEMBERSHIP OF THE TASK TEAM

6.1 This document was prepared by the Mining and Mineral Policy Unit and the Occupational Health Chief Directorate of the **DMR** for consultation with the **MHSC**.

6.2 The following persons played active roles in the initial development of this guideline:

STATE	ORGANIZED LABOUR	EMPLOYERS	TECHNICAL ADVISORS
T. Motitimi (Chairperson)	M. Llale	M. Biffi	R. Bergh (**CSIR**)
J. Legadima		J.C. Herbst	L. Bologo (**CSIR**)
		M. van Deventer	M. Fourie (**MRS**)
		J. Janse van Rensburg	C. de Klerk (**MRS**)
		I. Labuschagne	W. Schreiber (**CSIR**)
		J. Maass	M. Sehlabana (**CSIR**)
		B. Yates	

PART B: AUTHOR'S GUIDE

1. The **COP** must, where possible, follow the sequence laid out in Part C: Format and content of the mandatory **COP**. All headings, paragraphs and sub-paragraphs should be numbered to facilitate cross-referencing. Wording must be unambiguous and concise.

2. It should be indicated in the **COP** and on each annexure to the **COP** whether:

2.1. Mandatory annexures form part of the guideline, compliance is mandatory where indicated and must be incorporated in the **COP**.

2.2. Discretionary annexures are provided for information or for consideration in the preparation of the **COP** (i.e. compliance is optional).

3. When annexures are used the numbering should be preceded by the letter allocated to that particular annexure and the numbering should start at one (1) again. (e.g. 1, 2, 3, A1, A2, A3…).

4. Whenever possible illustrations, tables and graphs should be used to avoid long descriptions and/or explanations.

5. When reference has been made in the text to publications or reports, references to these sources must be included in the text as footnotes or side notes as well as in a separate bibliography.

PART C: FORMAT AND CONTENT OF THE MANDATORY COP

1. TITLE PAGE

The **COP** should have a title page reflecting at least the following:

1.1. The name of mine;

1.2. The heading: “Mandatory Code of Practice for the management of self-contained self-rescuers in mines”;

1.3. A statement to the effect that the **COP** was drawn up in accordance with guideline **DMR 16/3/2/4-A8** issued by the **CIOM**;

1.4. The mine reference number for the **COP**;

1.5. The effective date; and

1.6. Revision dates (if applicable).

2. TABLE OF CONTENTS

The **COP** must have a comprehensive table of contents.

3. STATUS OF THE COP

The **COP** should set out the processes followed for the identification and assessment of the significant risks outlined in paragraph 7.1 and how these will be addressed. The **COP** should address at least the aspects set out in this section unless there is no significant risk associated with that aspect in relation to **deployment** of **SCSRs** at the mine:

3.1. This section must contain statements to the effect that:

3.1.1. The **COP** was drawn up in accordance with guideline **DMR 16/3/2/4-A8** issued by the **CIOM**.

3.1.2. This is a mandatory **COP** in terms of sections 9(2) and (3) of the **MHSA**.

3.1.3. The **COP** may be used in an incident/accident investigation/inquiry to ascertain compliance and also to establish whether the **COP** is effective and fit for purpose.

3.1.4. The new version of the **COP** supersedes all previous versions of the same.

3.1.5. All managerial instructions, recommended procedures (voluntary **COPs**) and standards on the relevant topics must comply with the **COP** and must be reviewed to assure compliance.

4. MEMBERS OF THE DRAFTING COMMITTEE

4.1. In terms of section 9(4) of the **MHSA** the employer must consult with the health and safety committee on the preparation, implementation or revision of any **COP**.

4.2. It is recommended that the employer should, after consultation with the **employees** in terms of the **MHSA**, appoint a committee responsible for the drafting of the **COP**.

4.3. The members of the drafting committee assisting the employer in drafting the **COP** should be listed giving their full names, designations, affiliations and experience. This committee should include competent persons sufficient in number to effectively draft the **COP**.

5. GENERAL INFORMATION

General relevant information relating to the mine must be stated in this section of the **COP**.

The following minimum information must be provided:

5.1. A brief description of the mine and its location;

5.2. The commodities produced;

5.3. The mining methods or combination of methods used at the mine must be listed. This section must discuss the degree of mechanization, taking care to identify the potential situation and or sources that could give rise to an **emergency**.

5.4. The unique features of the mine that have a bearing on this **COP** must be set out and cross-referenced to the risk assessment conducted e.g. approximate number of workers and sections of the mine where the **deployment** of **SCSR** is required either by **MHSA** Regulation 16 or the mine's own risk assessment.

6. TERMS AND DEFINITIONS

Any word, phrase or term of which the meaning is not absolutely clear, or which will have a specific meaning assigned to it in the **COP**, must be clearly defined. Existing and/or known definitions should be used as far as possible. The drafting committee should avoid jargon and abbreviations that are not in common use or that have not been defined. The definitions section should also include acronyms and technical terms used.

7. RISK MANAGEMENT

7.1. To assist the employer to manage risks associated with the **deployment** of **SCSRs**, all relevant information such as lessons learned from incidents involving **SCSRs**, results from the **SCSR** functional performance test, research reports, manufacturers' specifications, approvals, design criteria and modifications related to the **SCSR** types in service at the mine and for all relevant ancillary equipment, should be obtained and considered for inclusion in the **COP** and revisions thereof and in the standard operating procedures associated therewith.

7.2. In addition to the periodic review required by section 11(4) of the **MHSA**, the **COP** should be reviewed and updated after incidents involving **SCSRs**; or after every **emergency**, altered circumstances, or if significant changes are introduced to procedures, mining and ventilation layouts, mining methods, plant or equipment and material.

8. ASPECTS TO BE ADDRESSED IN THE COP

The **COP** should set out the processes followed for the identification and assessment of the significant risks outlined in paragraph 7.1 and how these will be addressed. The **COP** should address at least the aspects set out in this section unless there is no significant risk associated with that aspect in relation to **deployment** of **SCSRs** at the mine:

8.1. SCSR selection criteria

8.1.1. Only types and makes of **BWSCSRs** approved in terms of **SANS 1737,** shall be considered for selection by the mine.

8.1.2. The criteria for the selection of the **SCSRs** in use at the mine must be outlined in the **COP** to demonstrate alignment with the **emergency** procedures that govern the orderly and safe evacuation of working places affected by a number of hazardous situations as stipulated in the mine's **COP** for **emergency** preparedness and response.

8.1.3. The **SCSR** selection criteria shall be based primarily on the anticipated duration of selected units, be these **BWSRSCs** or **LDSCSRs**, as required by the **emergency** response strategy. The **SCSRs** anticipated duration shall be based on the layout of escape routes, distance to and between places of safety along these, predicted levels of visibility, any use of locating systems to cater for poor visibility (e.g. lifelines, acoustic directional systems, etc. where these form part of the mine's escape strategy). In addition, it shall be demonstrated that the distances from the various working places to the respective places of safety and between places of safety along escape routes are within the recorded duration and demonstrated life-saving potential of the selected units as indicated by **SANS** batch testing and by the results from the mine's annual functional performance test (refer to **MHSA** Regulation 16.4).

8.2. SCSR logistics management

8.2.1. Procedures for personal **SCSR** allocation to all **employees** intended to be issued with **SCSRs** when signing-on or when transferred;

8.2.2. Procedures for **SCSR** lamp-room issuing and collection at the beginning and at the end of each shift respectively;

8.2.3. Procedures for **SCSR** storage during the off-shift periods;

8.2.4. Checking of **SCSRs** and any condition-monitoring by lamp-room staff;

8.2.5. Training of **employees** in the **donning** and use of **SCSRs**;

8.2.6. Training of the lamp room and relevant staff in the routine inspection of **SCSRs**, and in handling **SCSRs** involved in incidents; and

8.2.7. **SCSR** selection and purchasing procedures.

For each of the above, the **COP** shall outline clear roles and responsibilities of individuals tasked with executing procedures and overseeing all related functions.

8.3. Issuing and deployment of SCSRs

8.3.1. Outline the process whereby **employees** required to be issued with **SCSRs** are identified and issued with a personally assigned **SCSR** following completion of the requisite training programme.

8.3.2. Measures shall be in place at all times to ensure that every **SCSR** is allocated solely to the designated employee once daily except in cases where defects have been encountered during routine checks or where the assigned unit has been withdrawn for functional performance testing, repairs or maintenance. Annexure C shows a typical sample of **SCSR** allocation or history record that may be considered in managing the **deployment** of **SCSRs**.

8.3.3. The mine shall ensure that at least 5 % of the total number of **SCSRs** in use at each shaft for the above occurrences and for day-**visitors** to the mine or to sections of the mine where **SCSRs** are to be deployed.

8.3.4. Where the **deployment** of **LDSCSRs** forms part of the mine's escape and rescue procedures, the **COP** shall outline the criteria for the location, storage and supervision of these units. The location of underground storage caches and change-over stations shall be clearly indicated on the mine's escape and rescue plan and associated documentation.

8.4. Training in the use of BWSCSRs

8.4.1. **Employees**

The **COP** shall detail procedures that will ensure that all **employees** are given adequate and annual (not exceeding 18 months) training in all aspects of the **donning** and use of **SCSRs** where this is required. The following aspects should be addressed also in terms of;

(a) Providing a clear understanding of the role of **SCSRs** in the mine's escape and rescue strategy and particularly of when the units need to be donned (e.g. **emergency** alarm conditions, supervisor's instructions, control room communication from surface, triggering of early warning systems, etc.).

(b) Ensuring that **employees** are familiar with the **donning** and activation procedures even in poor visibility. Training procedures should be based primarily on the **SCSR OEM's** operational and training manual.

(c) Where needed, providing training material that includes experiential training methodology including sufficient physical, cognitive, psychological, and behavioural information beyond the necessary technical information supplied

by the **OEM** and hands-on experience. This will allow **employees** an adequate understanding of any potential physical and psychological symptoms which they might experience when **donning** and using **SCSRs**.

(d) Exposure to conditions likely to be encountered when **SCSRs** are being donned, inclusive of elevated breathing resistance levels and of increases in inhaled air temperature.

(e) Simulation awareness training shall include:

i) **Donning** procedure;
ii) "**Cold start**" procedures, where required (refer to Guidance Note 1 - mandatory);
iii) Changeover procedures (where required at underground change-over stations).

8.4.2 Visitors

The **COP** shall detail procedures that will ensure that all **visitors** are trained in the **donning** and use of **SCSRs** in accordance with accepted procedures but may exclude experiential training.

The **COP** shall stipulate that **visitors** shall be under direct supervision of a mine official at all time in areas where **SCSRs** are required.

8.5. Functional performance testing

The performance tests shall be conducted by an **ATA** as required by **MHSA** Regulation 16.

The **COP** shall set-out procedures to ensure that regular functional testing of a representative sample of the **SCSRs** deployed at the mine are carried out in accordance with **MHSA** Regulation 16.4 shall be done annually:

(a) The representative sample for performance testing shall be at least 1% of each make and type of **SCSR** in this category. (e.g. the mine has a total of 2 500 **SCSRs**, say 800 Make A and 1 700 Make B. The 1% sample will comprise at least 8 Type A and 17 Type B).

(b) The **ATA** may, at their discretion, and in consultation with the mine, recommend increasing temporarily the test sample size for the make / type / batch of **SCSRs** which have shown untoward behaviour during the monitoring programme or ongoing conformity assessment testing for that batch.

The mine shall ensure that the **ATA** is duly accredited to carry out these tests. Proof of such accreditation shall be kept by the mine.

8.6. Reporting and recordkeeping

8.6.1. Define requirements for the recording of information in terms of **MHSA** Regulation 16.4 for a minimum period of 24 months.

8.6.2. Stipulate procedures for the safe-keeping and use of reports and records issued by the testing authorities appointed in terms of **MHSA** Regulation 16.4.1 and 16.4.2 to provide the guidance necessary for reviewing and updating the mine's rescue and escape strategy and location of places of safety associated therewith.

8.6.3. Proof of batch test compliance shall be kept on record by the mine for all batches of **SCSRs** for the lifespan of the units, until all units in a specific batch are withdrawn from service permanently

8.7. Maintenance, incident management and disposal of SCSRs

8.7.1. Outline measures to ensure that visual inspection and maintenance procedures for **SCSRs** are in place together with regular lamp-room inspection routines including **SCSR** leak testing. Refer to Annexure B Guidance Note 2 - Leak testing (mandatory). Any visible defects as identified in the **OEM** specification that could affect the performance of the **SCSR** shall lead to the unit being withdrawn from service.

8.7.2. Indicate whether the maintenance of **SCSRs** deployed at the mine shall be done by the **OEM** or by duly competent mine **employees** formally accredited by the **OEM** and operating within technical procedures endorsed or generated by the **OEM.**

8.7.3. Outline precautionary measures and procedures to be followed when **SCSRs** are accidentally activated or malfunction or following an incident where **SCSRs** were activated during an **emergency**. These procedures should be devised to address different levels of incident investigations to be held by the employer jointly with the **OEM** and testing authority. Procedures shall also outline reporting requirements of these incidents to the **DMR**.

8.7.4. Considering the highly reactive nature of the oxygen-producing chemicals used in **SCSRs**, the **COP** shall detail adequate and safe disposal procedures for **SCSRs** that are withdrawn permanently from **deployment**.

8.7.5. Where **SCSRs** that are still within their ten-year operating life, are sold to a third party, the mine shall transfer the records relating to the units and respective batches sold to the new owner. Detailed records of such sales or transfers shall be kept by the original owner.

8.7.6. **SCSRs** that have become obsolete, that is units that are older than ten years from their date of manufacture, shall be withdrawn from service forthwith.

8.8. Instruction manual on the use of SCSRs

Relevant provisions of **OEM's** instruction and operating manuals for the type of **SCSRs** purchased are included in relevant standard operating procedures. These shall contain, but shall not be limited to the following:

(a) General information.

(b) Rated duration in accordance with **SANS 1737** certification.

(c) Technical information.

(d) Principles of operation.

(e) Description of apparatus.

(f) Conditions of use.

(g) Estimated service life as stated by the **OEM**.

(h) Risk assessment.

(i) Training requirements and training materials.

(j) Any basic inspection and maintenance procedures.

(k) Recommended disposal procedures.

PART D: IMPLEMENTATION

1. IMPLEMENTATION PLAN

1.1. The employer must prepare an implementation plan for its **COP** that makes provision for issues such as organizational structures, responsibilities of functionaries and programs and schedules for the **COP** that will enable proper implementation of the **COP**. (A summary of/and a reference to, a comprehensive implementation plan may be included).

1.2. Information may be graphically represented to facilitate easy interpretation of the data and to highlight trends for the purpose of risk assessment.

1.3. Enforcement and monitoring of the Guideline's implementation will be done in line with the audit program/s carried out by the **MHSI**.

2. COMPLIANCE WITH THE CODE OF PRACTICE

The employer must institute measures for monitoring and ensuring compliance with the **COP**.

3. ACCESS TO THE CODE OF PRACTICE AND RELATED DOCUMENTS

3.1. The employer must ensure that a complete **COP** and related documents are kept readily available at the mine for examination by any affected person (describe the process).

3.2. A registered trade union with members at the mine or where there is no such union, a health and safety representative on the mine, or if there is no health and safety representative, an employee representing the **employees** on the mine, must be provided with a copy of the written request to the manager. A register must be kept of such persons or institutions with copies to facilitate updating of such copies.

3.3. The employer must ensure that all **employees** are fully conversant with those sections of the COP relevant to their respective areas of responsibility.

ANNEXURE 1: Guidance Note 1 (mandatory)
SCSR cold start procedure generic notes on fires

This procedure shall be carried out if the unit's breathing bag does not inflate immediately after activating the starter.

In this case:

1. Remove nose clip.
2. Inhale from ambient atmosphere through nose.
3. Exhale into mouth piece.
4. Repeat above actions six times with a full breath each time.
5. Refit nose clip.
6. Breathe normally into the mouthpiece.

This procedure shall be included into the training procedures, where applicable.

ANNEXURE 2: Guidance Note 2 (mandatory)
Leak testing (for lamp-rooms only)

The following criteria must be implemented:

- Leak testing must meet the requirements of **SANS 1737**.
- Leak test shall adhere to a series of physical performance and basic specifications.
- A benchmark must be set stipulating minimum pressure measurements and standard evacuation times.

Leak test parameters:

- For shallow mining (i.e. mines less than 500m in depth, e.g. coal mines)

  Test pressure = -70mbar or -7000Pa or -7kpa or -0.07bar

- For deep mining (i.e. mines deeper than 500m in depth, e.g. gold and some platinum mines)

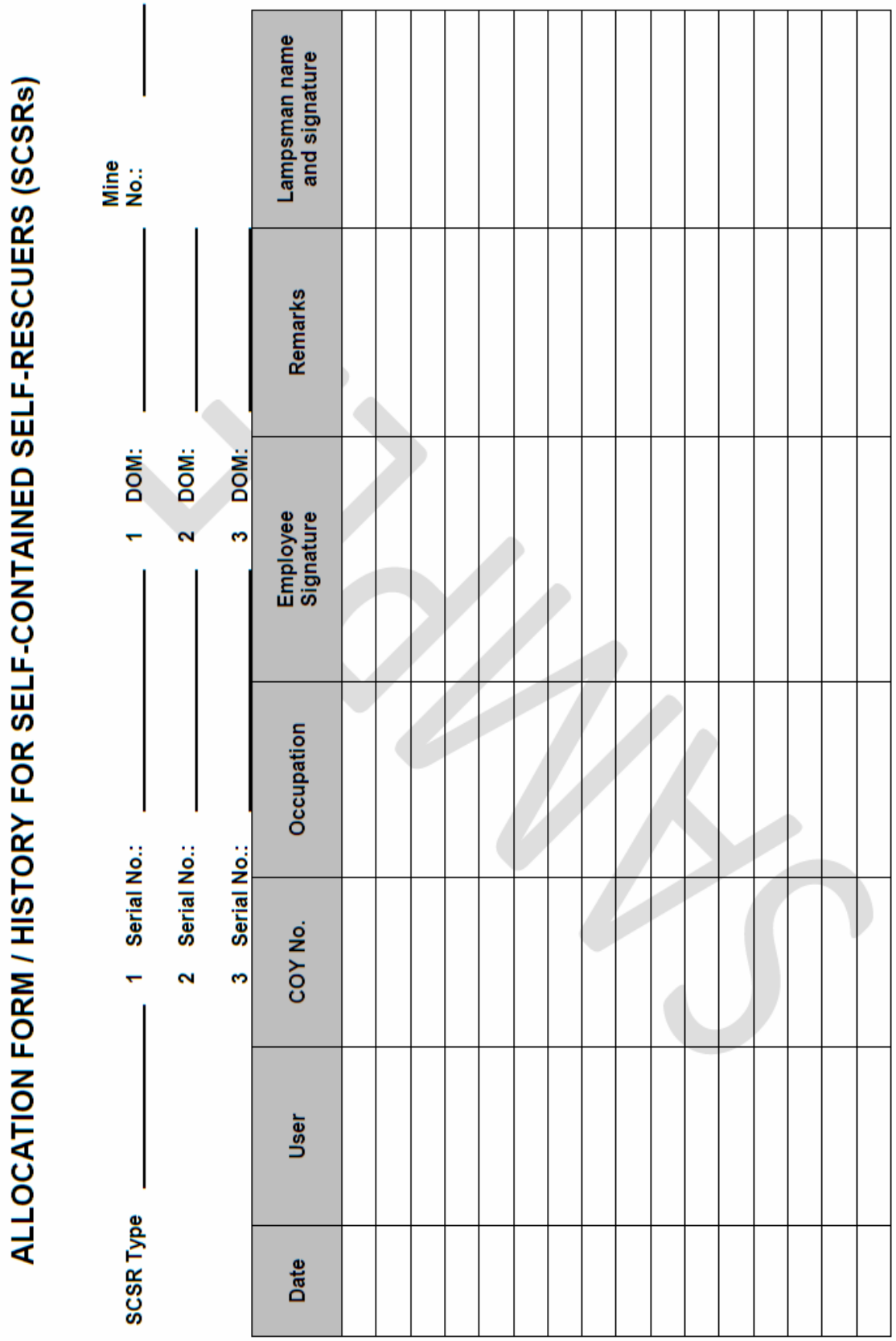
  Test pressure = -200mbar or -20000Pa or -20kpa or -0.2bar

Leak test intervals should be indicated, based on risk assessment, but should be performed at least bi-annually.

ANNEXURE 3: Sample allocation form for SCSR allocation history records

Mine Health and Safety Act, 1996 (Act 29 1996) Regulations Chapter 16 (Draft)

(For information purposes)



ALLOCATION FORM / HISTORY FOR SELF-CONTAINED SELF-RESCUERS (SCSRs)

SCSR Type _____ Mine No.: _____

1 Serial No.: _____ 1 DOM: _____

2 Serial No.: _____ 2 DOM: _____

3 Serial No.: 3 DOM:

Date	User	COY No.	Occupation	Employee Signature	Remarks	Lampsman name and signature

ANNEXURE 4: References

a) Brenkley, D; Bennet, S.C. and Jones, B.1999. Enhancing Mine **Emergency** Response. Paper presented to 28th International Conference on Safety in Mines Research Institutes, Sinaia, Romania. [Online]

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