	Standard	Generation Engineering
---	-----------------	-------------------------------

Title: **Arc Flash Protective Clothing and Personal Protective Equipment (PPE) against the Thermal Hazard of an Electrical Arc Standard**

Unique Identifier: **240-70044736**

Alternative Reference Number: **N/A**

Area of Applicability: **Engineering, Eskom**

Documentation Type: **Standard**

Revision: **4**

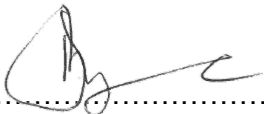
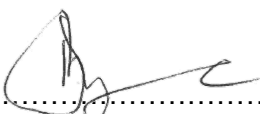

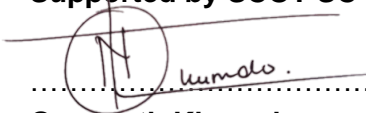
Total Pages: **25**

APPROVED FOR AUTHORISATION

☒ GENERATION ENGINEERING
DOCUMENT CENTRE ☎ x4962

Next Review Date: **February 2029**

Disclosure Classification: **CONTROLLED DISCLOSURE**

Compiled by	Approved by	Authorised by
		
Dyke Monyane Chief Technologist: Generation Engineering, Electrical Engineering	Dyke Monyane CG Convener: Metal Enclosed Switchgear CG	Kerseri Pather General Manager: Risk and Sustainability
Date: 08/02/2024	Date: 08/02/2024	Date: 09/02/2024
		Supported by SCOT SC
		
		Queeneth Khumalo SCOT SC Chairperson
		Date: 08/02/2024

PCM Reference: **240-53459028**

SCOT Study Committee Name: **Metal Enclosed Switchgear and Cable Systems SC**

CONTENTS

	Page
1. INTRODUCTION	3
2. SUPPORTING CLAUSES	3
2.1 SCOPE	3
2.1.1 Purpose	3
2.1.2 Applicability	3
2.2 NORMATIVE/INFORMATIVE REFERENCES	3
2.2.1 Normative	3
2.2.2 Informative	5
2.3 DEFINITIONS	5
2.3.1 Disclosure Classification	6
2.4 ABBREVIATIONS	6
2.5 ROLES AND RESPONSIBILITIES	6
2.6 PROCESS FOR MONITORING	7
2.7 RELATED/SUPPORTING DOCUMENTS	7
3. REQUIREMENTS	7
3.1 GENERAL	7
3.2 MINIMUM REQUIREMENTS FOR PERSONAL PROTECTIVE CLOTHING GARMENTS	7
3.2.1 General	7
3.2.2 Material requirements	8
3.2.3 Test and specification requirements	8
3.2.4 Design requirements	9
3.3 MINIMUM REQUIREMENTS FOR PERSONAL PROTECTIVE EQUIPMENT	10
3.3.1 Face protective equipment	10
3.3.1.1 Eye protection (goggles and visors)	10
3.3.1.2 Balaclava	10
3.3.1.3 Hood	10
3.3.2 Minimum requirements for gloves	10
3.3.3 Minimum requirements for rainwear	11
3.3.4 Minimum requirements for safety shoes	11
3.3.5 Minimum requirements for hearing protection	11
3.3.6 Minimum requirements for arc protective blanket to cover Switchboards	11
3.4 MARKING AND LABELLING	11
3.5 SELECTION CRITERIA OF PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT	12
3.6 CARE AND MAINTENANCE OF PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT	12
3.7 LIST OF PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT AND THEIR STANDARDS	13
4. AUTHORISATION	16
5. REVISIONS	16
6. DEVELOPMENT TEAM	17
APPENDIX A : TECHNICAL SCHEDULE A AND B	18
APPENDIX B : CHECK LIST ON COMPLIANCE UPON RECIEVING PPE	24

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

1. INTRODUCTION

This specification satisfies the need for the standardisation of the requirements for Arc Flash Protective Clothing and Equipment to comply with personnel safety, related legal and Eskom requirements. In a case where a particular PPE requirement is not covered in this specification, the onus is on the Division and/or BU to ensure compliance with all safety requirements in accordance with the relevant standards, regulations or codes of practice for that specific PPE equipment.

This specification does not address electrical shock, arc blast (projectiles, shock waves and hot oil release), the consequences of physical and mental shock and the toxic influences of an electric arc.

The requirements of this specification are in accordance with **SANS 724** standard.

2. SUPPORTING CLAUSES

2.1 SCOPE

This document covers the requirements for the garment and accessories in manufacturing, testing and selection for Arc Flash Personal Protective Equipment against the thermal hazards resulting from an electric arc.

2.1.1 Purpose

The purpose of this specification is to provide minimum requirements to be adhered to during the manufacturing, testing and selection of personal protective equipment and protective clothing against the thermal hazards resulting from an electrical arc. In addition, it covers the design, selection and performance requirements of arc rated clothing and equipment.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

NOTE: the arc flash protective equipment that was purchased before the approval of these standard that meets the requirements of the previous revision shall continue to be used until it is due for replacement.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

- | | | |
|-----|---------------|---|
| [1] | ISO 9001 | Quality Management Systems. |
| [2] | ISO/IEC 17025 | General Requirements for the Competence of Testing and Calibration Laboratories |
| [3] | SANS 724 | Personal protective equipment and protective clothing against the thermal hazard of an electrical arc. |
| [4] | 240-44175132 | Eskom Personal Protective Equipment Specification. |
| [5] | 240-56179027 | Generation Safety Measures against the Thermal Hazard of an Electrical Arc for Metal-Enclosed Switchgear (up to 15kV) Standard. |

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

- [6] NFPA 70E Standard for electrical safety in the workplace.
- [7] NFPA 2112:2018 Standard on flame resistance clothing for protection of industrial personnel against short-duration thermal exposures from fire.
- [8] SANS 984 IEEE guide for performing arc-flash hazard calculations.
- [9] ANSI Z 87.1 Practice for occupational and educational eye and face protection.
- [10] ASTM F1506 Standard performance specification for flame resistant textile materials for wearing apparel for use by electrical workers exposed to momentary electric arc and related thermal hazards.
- [11] ASTM D6413 Standard Test Method for Flame Resistance of Textiles (Vertical Test).
- [12] ASTM F2675/F2675M-13 Standard Test Method for Determining Arc Ratings of Hand Protective Products Developed and Used for Electrical Arc Flash Protection.
- [13] ASTM F1891 Standard specification for arc and flame-resistant rainwear.
- [14] ASTM F1959 Standard test method for determining the arc rating of materials for clothing.
- [15] ASTM F2178 Standard test method for determining the arc rating and standard specification for face protective products.
- [16] ASTM F2621 Standard practice for determining response characteristics and design integrity of arc-rated finished products in an electric arc exposure.
- [17] ASTM F2676 Standard test method for determining the protective performance of an arc protective blanket for electric arc hazards.
- [18] ASTM D123-19 Standard terminology relating to textiles.
- [19] AATCC Standard test method 135 for dimensional changes in automatic home laundering of woven and knitted fabrics.
- [20] EN 166 Personal eye-protection Specification.
- [21] ISO 17493 Clothing and equipment for protection against heat. Test method for convective heat resistance using a hot air circulating oven.
- [22] SANS 61482-1-1 Live working – Protective clothing against the thermal hazards of an electric arc – Part 1-1: Test methods – Method 1: Determination of the arc rating (ELIM, ATPV and/or EBT) of clothing materials and of protective clothing using an open arc.
- [23] SANS 61482-2 Live working – Protective clothing against the thermal hazards of an electric arc – Part 2: Requirements.
- [24] SANS 434 Boiler suits and work wear suits (for purpose of sizing).
- [25] SANS 1397 Industrial safety helmets.
- [26] SANS 10011 Care-labelling of textile piece-goods, textile articles and clothing.
- [27] SANS 10235 Fibre-content labelling of textiles and textile products.
- [28] SANS 20345 Personal protective equipment – Safety footwear.
- [29] SANS 50352-1 Hearing protectors – Safety requirements and testing – Part 1: Ear-muffs.

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

[30] SANS 50352-2 Hearing protectors – Safety requirements and testing – Part 2: Ear-plugs.

2.2.2 Informative

[31] Not Applicable

2.3 DEFINITIONS

Definition	Description
Acceptable	Means acceptable to the authority administering this specification, or to the parties concluding the purchase contract, as the case may be.
Arc Rating	The value attributed to materials that describe their performance to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm ² and is derived from the determined value of the arc thermal performance value (ATPV) or energy of break open threshold.
After-flame	Persistent flaming of a material after the ignition source has been removed.
Arc Thermal Performance Value	In arc testing, this means the incident energy on a material or multilayer system of materials that results in a 50% probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of a second-degree skin burn injury based on the Stoll curve, without breaking open. NOTE: ATPV is expressed in kJ/m ² or kWxs/m ² (cal/cm ²).
Breakopen Threshold Energy	In electric arc testing, this means numerical value of incident energy attributed to product (material or clothing) that describes its breakopen properties when exposed to heat energy generated by an electric arc. NOTE: EBT is expressed in kJ/m ² or kWxs/m ² (cal/cm ²).
Breakopen	In electrical arc testing, this means the material response evidenced by the formation of one or more openings in the material which may allow flame to pass through the material. NOTE 1: the specimen is considered to exhibit break open when any opening is at least 300 mm ² in area or at least 25 mm in any dimension. A single thread across the opening does not reduce the size of the hole for the purpose of SANS 61482-1-1 or ASTM F1959. NOTE 2: a multilayer specimen is considered to exhibit break open when all layers show the formation of one or more openings.
Flame resistance (flame resistant)	The property of a material whereby flaming combustion is prevented, terminated, or inhibited following application of a flaming or non-flaming source of ignition, with or without subsequent removal of the ignition source. (ASTM D123-19)

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

Definition	Description
	Note: Flame retardant – Fabrics that are chemically treated to impact flame resistance.
Garment	A single item of clothing (e.g. shirt, trouser, jacket) which may consist of a single layer or multiple layers.
Material	Fabric or other substance from which the garment is made; this may consist of a single or multiple layers
Personal Protective Equipment	All items, including head, face, neck and chin protection, eye protection, hearing protection, body protection, hand and arm protection, foot and leg protection, that is intended to protect a person against the thermal hazards of an electric arc
Protective clothing	An assembly of garments which covers or replaces personal clothing, and which is designed to provide protection against one or more hazards.

2.3.1 Disclosure Classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
ATPV	Arc thermal performance value
EBT50	Break-open threshold energy
FR	Flame resistant
HRC	Hazard risk category
PPE	Personal protective equipment
GMR	General Machinery Regulations

2.5 ROLES AND RESPONSIBILITIES

Power stations' Distribution and Transmission Safety departments are accountable for safety of personnel and therefore shall ensure that Arc Flash PPE is available and complies with this standard.

Commercial department shall ensure that correct Arc Flash PPE that complies with this standard is procured.

Electrical Engineering department shall perform technical evaluation when Station/Business Unit acquires Arc Flash PPE items.

GMR2.1 appointees, throughout Eskom Holdings shall ensure safety of personnel by ensuring that Arc Flash PPE complies with this standard is used.

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

2.6 PROCESS FOR MONITORING

Not Applicable.

2.7 RELATED/SUPPORTING DOCUMENTS

Not applicable.

3. REQUIREMENTS

3.1 GENERAL

- a) Personal protective clothing (Fabric and garments) and personal protective equipment shall be manufactured at an ISO 9001 accredited facility.
- b) Type test authorities (laboratories) for personal protective clothing (fabric and garments) and personal protective equipment shall be accredited in accordance with ISO/IEC 17025.
- c) Thermal Arc Protective Equipment and clothing shall be worn by employees who are at risk of being exposed to the thermal hazard of electrical arc.
- d) PPE must be the last means of protection against hazards.
- e) PPE must be kept in a good condition and in working order.
- f) The user must ensure that PPE is cleaned, stored, maintained, and used according to the manufacturer's specifications.
- g) The employer shall ensure that the user is trained in the use and limitations of the PPE supplied.
- h) The employer may not allow an employee to work unless an employee is issued with PPE specific to the hazard to which the employee will be exposed.
- i) All PPE shall comply with SANS 724.

3.2 MINIMUM REQUIREMENTS FOR PERSONAL PROTECTIVE CLOTHING GARMENTS

3.2.1 General

- a) Arc rating shall be expressed as "Arc-thermal performance value" (ATPV).
- b) In the case of garment certification, both the material and the garment shall comply with the relevant requirements for the item.
- c) The arc rating of the protective clothing is determined by the rating of the garment with the lowest arc rating, for example protective clothing that consists of a 20 cal/cm² hood, 40 cal/cm² jacket and 25 cal/cm² trousers shall have system overall of arc rating of 20 cal/cm².
- d) Individually rated garments cannot be used together to achieve a high rating e.g. The 8 cal/cm² jacket plus 4 cal/cm² shirt is NOT equal to 12 cal/cm².
- e) During its service life, protective clothing shall keep its arc thermal properties when cleaned in accordance with the instructions for use. The manufacturer shall stipulate the service life of a garment in terms of the cleaning cycles or in terms of other means acceptable to both the manufacturer and the user. Such other means shall be explained in writing during the procurement phase.

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

- f) Fabric that makes up the garments shall be subjected to washing cycle procedure set out in **NPFA 2112**. The garments shall last for a minimum of **100 cleaning cycles** without compromising arc rating properties.
- g) All garments that have been exposed to an electric arc flash shall be withdrawn from service.
- h) The size ranges of protective clothing shall be in accordance with the requirements of SANS 434.
- i) Dimensional changes shall not exceed 3% on exposure to heat (washing), which shall be calculated in accordance with ASTM F1506.
- j) Non-melting underwear (e.g. cotton, silk, rayon) shall be worn when the arc rated garment is used.
- k) Where garment pieces of various suppliers are used, it is required that the user ensure the type tested combination of garments are not compromised.
- l) Garments that are not arc rated shall not be permitted to be used to increase the arc rating of a garment or of the clothing.
- m) Garments worn as outer layers over arc rated clothing, such as jackets or rainwear, shall also be made from arc rated material.

3.2.2 Material requirements

- a) Material used in the construction of garments shall comply with the requirements of IEC 61482-2 or ASTM F1506.
- b) The arc rating of the fabric or a multi-layer combination of fabrics shall be tested in accordance with the test methods given in SANS 61482-1-1 or ASTM F1959.
- c) The fabric shall be subjected to flame resistance test as specified in 8.3 of NFPA 2112:2018.
- d) Fiber blends that contain materials that melt, such as acetate acrylic, nylon, polyester, polyethylene, polypropylene and spandex, shall be permitted if such blends meet the requirements of ASTM F1506, and if such blends in fabrics do not exhibit evidence of melting and sticking hazard during arc testing according to ASTM F1959/F1959M.

3.2.3 Test and specification requirements

- a) Protective clothing shall comply with the requirements of IEC 61482-2 or ASTM F2621.
- b) When protective clothing constructed from single-layer material is tested, no part of the protective clothing shall display an after-flame of longer than 2 seconds. Garments shall not break open and all findings, thread, fasteners, closures and accessories holding the garment together shall perform as expected, and no ignition, melting and dripping or other effects that could reduce the protection of the user shall occur.
- c) When protective clothing constructed from multi-layered fabric is tested, no part of the protective clothing shall display a limited after-flame of more than the greatest after-flame time in the SANS 61482-1-1 or ASTM F1959 test reports. Garments shall not break open and all findings, thread, fasteners, closures and accessories holding the garment together should perform as expected, and no ignition, melting and dripping or other effects that could reduce the protection of the user shall occur.

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

- d) Compliance with the requirements in 3.3.3 (a), 3.3.3(b) and 3.3.3(c) shall be noted in the test report or test certificate.

3.2.4 Design requirements

- a) The garment shall be designed in such a way that it does not influence or hinder the wearer in performing his/her work.
- b) Garments that protect the upper part of the body shall have long sleeves up to the wrists with cuffs.
- c) Garments shall cover potentially exposed areas as completely as possible.
- d) Loose-fitting clothing shall be supplied to provide additional thermal insulation because of air space. Very tight-fitting garment are not allowed.
- e) The fasteners of a garment shall be designed in such a way that the opening function is still present and operational after exposure to an electrical arc.
- f) The thread, fasteners, findings and closures used in the construction of a garment shall not contribute to the severity of injuries to the wearer in the event of an electric arc.
- g) No exposed external metal shall be permitted in the clothing. If internal metal or thermoplastic parts (e.g. fasteners, buttons and accessories) are used, they shall be covered on the inside to prevent skin contact.
- h) The sewing thread utilised in the construction of garments shall not melt when tested at a temperature of 260 °C in accordance with ISO 17493. There are many seams that have no influence on the protection of the wearer (e.g. hems etc.)
- i) The colour of both the jacket and pants should preferably be Navy blue Pantone 19_3920 or Royal blue Pantone 19_3955.
- j) The arc suits shall be fitted with flame resistant or retardant reflective strips on the circumference of both sleeves on the inner upper arm of the jacket, and with reflective strips on both legs above the knees. The reflective strips shall be visible in the day and at night.
- k) The Eskom logo shall appear on the left top side of the jacket in white and shall be in accordance with the Eskom Corporate Identity. The thread used for the embroidery shall comply to the requirements stipulated in SANS 724.
- l) The Zero Harm identification shall appear on the right side sleeve of the top of the jacket and shall be in accordance with the Eskom Corporate Identity. The thread used for the embroidery shall comply with the requirements stipulated in SANS 724.
- m) The shirts shall be corporate colour (grey), (CKS 129-188c).
- n) The Eskom logo shall appear on the left top side of the shirt/jacket in white and shall be in accordance with the Eskom Corporate Identity, below it shall be the ATPV value of the garment. The thread used for the embroidery shall comply with the requirements stipulated in SANS 724.
- o) The Zero Harm identification shall appear on the right side sleeve of the top of the shirt and shall be in accordance with the Eskom Corporate Identity. The thread used for the embroidery shall comply with the requirements stipulated in SANS 724.

CONTROLLED DISCLOSURE

- p) **Pockets** are allowed on the garment. Pockets of the jacket shall be patch pockets of outer material and shall have round corners. The pants shall have five pocket style which shall exclude the ruler/carpenter pocket. The pockets shall be made from the same material as the garment.

3.3 MINIMUM REQUIREMENTS FOR PERSONAL PROTECTIVE EQUIPMENT

3.3.1 Face protective equipment

3.3.1.1 Eye protection (goggles and visors)

- a) Eye protective equipment shall comply with the requirements of EN 166 and ASTM F2178 or ANSI Z 87.1. Face protective equipment, which may incorporate eye protection, shall comply with the requirements of ANSI Z 87.1 and ASTM F2178. This include the requirements for infrared protection (the wearer's vision shall not be obstructed).
- b) The arc rating of the visor shall be equal to or higher than the value assigned to the hood.
- c) The visor and the face shield must be anti-scratch in accordance with ANSI Z 87.1 and or EN 166.
- d) The visor and face shield must be anti-fog in accordance with EN 166.
- e) Eye protection shall be marked and care-labelled in accordance with EN 166 or ANSI Z 87.1.

3.3.1.2 Balaclava

- a) Arc-rated material must be used for a balaclava, arc rated, consistent with the construction, design and protection of the garments.
- b) The test report on the thermal performance of the balaclava is required.

3.3.1.3 Hood

- a) Fabric used for hoods shall be of the same, or higher, arc rating as that for protective clothing and shall fully cover the chest, neck and head of the user.
- b) Fabric used for hoods shall be arc rated material that is permanently flame resistant so that the flame-resistant quality of the material (i.e. the material does not continue to burn after exposure to and removal of a source of ignition) cannot be removed due to usage and/or laundering.
- c) The arc rating shall be indelibly marked on the fabric of the hood.
- d) When hoods are tested in accordance with ASTM F2178, they shall comply with the requirements of ASTM F1506 or IEC 61482-2.
- e) When exterior air is supplied into the hood, the air hoses and pump housing shall be either covered by arc rated or constructed of non-melting and non-flammable materials.
- f) The colour of the hood should preferably be Navy blue Pantone 19_3920 or Royal blue Pantone 19_3955.

3.3.2 Minimum requirements for gloves

- a) Hand protection shall be of arc rated material and tested in accordance with ASTM F2675/F2675M-13.

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

- b) The test report on the thermal performance of the gloves is required.

3.3.3 Minimum requirements for rainwear

- a) Rainwear shall comply with the requirements of ASTM F1891.
- b) The rainwear shall be Navy blue or Royal blue in colour.
- c) The rain suits shall be fitted with flame resistant or retardant reflective strips on the circumference of both sleeves on the inner upper arm of the jacket, and with reflective strips on both legs above the knees. The reflective strips shall be visible in the day and at night.
- d) The Zero Harm identification shall appear on the right side of the sleeve and shall be in accordance with Eskom's Corporate Identity.
- e) The Eskom logo shall be silk-screened in accordance with Eskom's Corporate Identity, on the front and back.
- f) The size of the Eskom logo on the front shall be 65 mm high and 150 mm high on the back.
- g) The jacket shall have a nylon zip and a closed fly front secured by non-conductive press-studs.

NOTE 1: some rainwear will not be constructed of fabric (see the definition of "material"). For this reason, and for the purposes of this standard, rainwear shall comply with the requirements of ASTM F1891.

NOTE 2: size designations are included in ASTM F1891.

3.3.4 Minimum requirements for safety shoes

- a) The shoes shall comply with the requirements of the electrical safety boots stated in Eskom 240-44175132 Eskom Personal Protective Equipment Specification.

3.3.5 Minimum requirements for hearing protection

- a) Hearing protection shall comply with the requirements of SANS 50352-1 or SANS 50352-2.

3.3.6 Minimum requirements for arc protective blanket to cover Switchboards

- a) The arc rating of the arc protective blankets shall be tested in accordance with the test methods given in ASTM F2676.
- b) Arc blanket shall have loops all around for securing in place.
- c) Arc blanket may be of single or multilayer fabric.
- d) The arc rating and dimensions of the arc blanket shall be specified during tendering stage.

3.4 MARKING AND LABELLING

- a) All labels shall be permanently secured so that they, including the marking, will outlast the service life of the garment.
- b) Arc flash protection clothing markings shall comply with SANS 10011 or ASTM F1506.
- c) The following information shall be included as a minimum on the label secured to the garment:
- The manufacturer's name or trade mark;

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

- Year of manufacture or garment serial number for purpose of tracking.
- The size designation;
- The arc rating designation ATPV;
- The composition of the material in accordance with SANS 10235 or ASTM F 1506;
- The care-labelling instructions in accordance with SANS 10011 or ASTM F1506;
- The service life (in accordance with 3.3.1 (f));
- The relevant normative marking requirements of referenced standards;
- The washing control label where applicable and;
- The arc-rating designation applicable to the material shall be clearly shown on the garment. For arc flash protection clothing, the ATPV designation applicable to the material and the Eskom logo shall be clearly visible on all components of the suit. Size of the letters shall be **20 mm in height and 3 mm in width.**

3.5 SELECTION CRITERIA OF PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

The selection criteria of personal protective clothing and equipment are contained in Eskom Arc Flash Safety standard [5].

3.6 CARE AND MAINTENANCE OF PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

- a) Arc rated clothing shall be inspected before each use.
- b) Arc rated clothing that are contaminated or damaged to the extent that their protective qualities are impaired shall not be used.
- c) Protective items that become contaminated with grease, oil, or flammable liquids or combustible materials shall not be used.
- d) Arc rated clothing shall be stored in a manner that prevents physical damage; damage from moisture, dust or other deteriorating agents; or contamination from flammable or combustible materials.
- e) When arc rated clothing is cleaned, manufacturer's instructions shall be followed to avoid loss of protection.
- f) Defective clothing shall be withdrawn from service handed back to the Employer and new AFP issued.

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

3.7 LIST OF PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT AND THEIR STANDARDS

Table 1 summaries Personal Protective Equipment and clothing and their corresponding standards. This table is intended to assist the personnel performing technical evaluation upon acquiring of the PPE/C.

Table 1: Personal Protective Equipment and Clothing items and their corresponding Standards.

ITEM	DOCUMENT TITLE	DOCUMENT NO.	OBJECTIVE OF THE TEST
1. Fabric (Material)	Standard test method for determining the arc rating of materials for clothing OR Live working – Protective clothing against the thermal hazards of an electric arc – Part 1-2: Test methods – Method 1: Determination of the arc rating (ELIM, ATPV and/or EBT50) of flame resistant materials for clothing.	ASTM F1959 OR SANS 61482-1-1	Test method for determining arc rating of a fabric
2. Arc rated clothing (garments)	Standard performance specification for flame resistant textile materials for wearing apparel for use by electrical workers exposed to momentary electric arc and related thermal hazards. OR Live working – Protective clothing against the thermal hazards of an electric arc – Part 2: Requirements.	ASTM F1506 OR IEC/SANS 61482-2	Performance requirements for clothing, namely: <ul style="list-style-type: none"> • Arc rating • Flame resistance of fabrics • Mechanical durability of fabrics • Garment construction and performance requirements
	Standard practice for determining response characteristics and design integrity of arc-rated finished products in an electric arc exposure.	ASTM F2621	Integrity tests for finished protective clothing product, namely: <ul style="list-style-type: none"> • Breakopen through garments • Closures and seams in arc

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

			<p>exposures</p> <ul style="list-style-type: none"> • Garments overlap/interface • Melting/dripping • After-flame duration • Deformation • Shrinkage • Ignition
	Standard on flame resistance clothing for protection of industrial personnel against short-duration thermal exposures from fire.	NFPA 2112: 2018. section (8.3)	Test for flame resistance of clothing. This test is to determine how easily fabrics ignite and how easily they continue to burn once ignited. To pass, materials cannot have an average after-flame time greater than 2 seconds, a char length greater than 102 mm or any melting with dripping.
3. Face protective equipment			
Eye protection (goggles and visors)	Personal eye-protection Specification.	EN 166	Safety standard for eyewear
	<p>Standard test method for determining the arc rating and standard specification for face protective products.</p> <p>OR</p> <p>Practice for occupational and educational eye and face protection.</p>	<p>ASTM 2178</p> <p>OR</p> <p>ANSI 87.1</p>	Standard test method for determining the Arc Rating and standard specification for Eye or Face Protective Products
Balaclava OR Hood	Standard performance specification for flame resistant textile materials for wearing apparel for use by electrical workers exposed to momentary electric arc and related	ASTM F1506	Arc performance requirements for clothing.

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

	thermal hazards. OR Live working – Protective clothing against the thermal hazards of an electric arc – Part 2: Requirements.	OR IEC/SANS 61482-2	
	Standard practice for determining response characteristics and design integrity of arc-rated finished products in an electric arc exposure.	ASTM F2621	Integrity test for protective clothing
4. Hands protection (Gloves)	Standard Test Method for Determining Arc Ratings of Hand Protective Products Developed and Used for Electrical Arc Flash Protection.	ASTM F2675/F2675M-13	Test method used for determining arc rating of hand protection products in a form of gloves, gloves materials, glove material systems.
5. Rain protection (Rainwear)	Standard specification for arc and flame-resistant rainwear	ASTM F1891	Arc performance requirements for the rainwear
6. Hearing protection	Hearing protectors – Safety requirements and testing – Part 1: Ear-muffs	SANS 50352-1	Safety requirements
	Hearing protectors – Safety requirements and testing – Part 2: Ear-plugs.	SANS 50352-2	Safety requirements

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

4. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
Phera Rakeketsi	Senior Manager (Acting) Gx Engineering, Electrical Engineering
Vonani Mathebula	Chief Engineer: Gx Engineering, Electrical Engineering
Nkule Khumalo	Electrical Engineering Manager - Arnot Power Station
Banele Mthethwa	Electrical Engineering Manager - Camden Power Station
Andile Nqayane	Electrical Engineering Manager - Duvha Power Station
Thabiso Mtsweni	Electrical Engineering Manager - Grootvlei Power Station
Rofhiwa Lethole	Electrical Engineering Manager - Hendrina Power Station
Remember Sigawuke	Electrical Engineering Manager - Kendal Power Station
Zieyaad Isaacs	Electrical Engineering Manager - Koeberg Power Station
Godfrey Mthombene	Electrical Engineering Manager (Acting) - Kriel Power Station
Mohapi Mphirime	Electrical Engineering Manager - Kusile Power Station
Theko Shete	Electrical Engineering Manager - Lethabo Power Station
Ryan Hector	Electrical Engineering Manager - Tutuka Power Station
Kefuoe Sejosing	Electrical Engineering Manager - Majuba Power Station
Louisa Bamuza	Electrical Engineering Manager - Matimba Power Station
Nkosinathi Maseko	Electrical Engineering Manager - Matla Power Station
Derrick Chauke	Electrical Engineering Manager - Medupi Power Station
Ian Kuiler	Electrical Engineering Manager - Peaking Power Stations
Mfundi Songo	Senior Manager -Technology and Engineering
Felix Bosch	Generation Engineering Documentation Manager

5. REVISIONS

Date	Rev.	Compiler	Remarks
October 2013	1	M. Bizior	First Revision Published after Review Process
September 2016	1.1	D. Monyane	Updated Draft after Comments Review Process
November 2016	2	D. Monyane	Final Rev 2 Document for Authorisation and Publication
March 2017	2.1	D. Monyane	Updated Draft from Study Committee Review Process
April 2017	3	D. Monyane	Final Rev 3 Document for Authorisation and Publication
June 2022	3.1	D. Monyane	Revised draft Document
August 2023	3.2	D. Monyane	Updated final draft after Formal Review process
February 2024	4	D. Monyane	Final Rev 4 Document Authorised for Publication

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

6. DEVELOPMENT TEAM

The following people were involved in the development of this document under Arc Flash PPE Work Group:

- Dyke Monyane
- Vonani Mathebula
- Ntokozo Ngubane
- David Ntombela
- Queeneth Khumalo
- Beverley Erasmus
- Brian Mokoena
- Vonnie Vermaas
- Gerhard Van Oudtshoorn
- Francois Dragner
- Hennie Cilliers

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

APPENDIX A: TECHNICAL SCHEDULE A AND B

Notes on filling in Schedule B

- If a blank space is left in Schedule B next to certain requirement specified in Schedule A, this constitutes a confirmation that the tenderer does not comply with that specific requirement.
- Where 'xxx' is indicated for an item in Schedule A, the tenderer is required to fill in the appropriate information in Schedule B, for the equipment offered.
- Where 'yyy' is indicated for an item in Schedule A, the tenderer is required to provide evidence in a form of a report or certificate number in Schedule B, for the equipment offered.

Item	Clauses of 240-70044736	Description	Schedule A	Schedule B
	3.1	REQUIREMENTS		
1	3.1.1	General		
1.1	a)	Name of manufacturing facility ISO 9001 accredited where garments are made. Provide evidence.	yyy	
1.2	b)	Name of testing authorities (laboratories) accredited in accordance with ISO/IEC 17025. Provide evidence.	yyy	
1.3	i)	All PPE shall comply with SANS 724	SANS 724	
	3.2	MINIMUM REQUIREMENTS FOR PERSONAL PROTECTIVE CLOTHING GARMENTS		
2	3.2.1	General		
2.1	a) i	Minimum ATPV for PPE Category 2.	12 cal/cm ²	
2.3	ii	Minimum ATPV for PPE Category 4.	50 cal/cm ²	
2.4	f)	Minimum number of washing cycles.	100 washes	
3	3.2.2	Material requirements		
3.1	a)	Material used in the construction of garments shall comply with the requirements of IEC 61482-2 or ASTM F1506. Provide report/certificate number on schedule B.	yyy	
3.2	b)	The arc rating of the fabric or a multi-layer combination of fabrics shall be tested in accordance with the test methods given in SANS 61482-1-1 or ASTM F1959. Provide report/certificate number on schedule B	yyy	
3.3	c)	The fabric shall be tested subjected to	yyy	

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

		flame resistance test as specified in 8.3 of NFPA 2112:2018. Provide report/certificate number on schedule B.		
4	3.2.3	Test and specification requirements		
4.1	a)	Protective clothing shall comply with the requirements of IEC 61482-2 or ASTM F2621. Provide report/certificate number on schedule B.	yyy	
4.2	b)	When single-layer material is tested, no part of the protective clothing shall display an after-flame of longer than 2 seconds. Provide report/certificate number on schedule B.	yyy	
4.3	c)	When multi-layered fabric is tested, no part of the protective clothing shall display a limited after-flame of more than the greatest after-flame time in the SANS 61482-1-1 or ASTM F1959 test reports. Provide report/certificate number on schedule B	yyy	
5	3.2.4	Design requirements		
5.1	a)	The garment shall be designed in such a way that it does not influence or hinder the wearer in performing his/her work.	Yes	
5.2	b)	Garments that protect the upper part of the body shall have long sleeves up to the wrists with cuffs.	Yes	
5.3	c)	Garments shall cover potentially exposed areas as completely as possible.	Yes	
5.4	d)	Very tight-fitting garment shall be avoided. Loose-fitting clothing provides additional thermal insulation because of air space.	Yes	
5.5	e)	The fasteners of a garment shall be designed in such a way that the opening function is still present and operational after exposure to an electrical arc.	Yes	
5.6	f)	The thread, fasteners, findings, and closures used in the construction of a garment shall not contribute to the severity of injuries to the wearer in the event of an electric arc.	Yes	

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

5.7	g)	No exposed external metal shall be permitted in the clothing. If internal metal or thermoplastic parts (e.g. fasteners, buttons and accessories) are used, they shall be covered on the inside to prevent skin contact.	Yes	
5.8	h)	The sewing thread utilised in the construction of garments shall not melt when tested at a temperature of 260 °C in accordance with ISO 17493.	Yes	
5.9	i)	The colour of both the jacket and pants should be Navy blue Pantone 19_3920 or Royal blue Pantone 19_3955.	Navy blue Pantone 19_3920 or Royal blue Pantone 19_3955	
5.10	j)	The arc suits shall be fitted with flame resistant or retardant reflective strips on the circumference of both sleeves on the inner upper arm of the jacket, and with reflective strips on both legs above the knees. The reflective strips shall be visible in the day and at night.	Yes	
5.11	k)	The Eskom logo shall appear on the left top side of the jacket in white and shall be in accordance with the Eskom Corporate Identity. The thread used for the embroidery shall comply to the requirements stipulated in SANS 724.	Yes	
5.12	l)	The Zero Harm identification shall appear on the right side of the sleeve of the top of the jacket and shall be in accordance with the Eskom Corporate Identity. The thread used for the embroidery shall comply with the requirements stipulated in SANS 724.	Yes	
5.13	m)	The shirts shall be corporate colour (grey), (CKS 129-188c).	Grey (CKS 129-188c)	
5.14	n)	The Eskom logo shall appear on the left top side of the shirt/jacket in white and shall be in accordance with the Eskom Corporate Identity, below it shall be the ATPV value of the garment. The thread used for the embroidery shall comply with the requirements stipulated in SANS 724.	Yes	
5.15	o)	The Zero Harm identification shall appear on the right side of the sleeve of the top of the shirt and shall be in	Yes	

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

		accordance with the Eskom Corporate Identity. The thread used for the embroidery shall comply with the requirements stipulated in SANS 724.		
5.16	p)	Garments are provided with pockets as specified.	Yes	
	3.3	MINIMUM REQUIREMENTS FOR PERSONAL PROTECTIVE EQUIPMENT		
6	3.3.1	Face protective equipment		
6.1	3.3.1.1	Eye protection (goggles and visors)		
6.1.1	a)	Eye protective equipment shall comply with the requirements of EN 166 and ASTM F2178 or ANSI Z 87.1. Provide report/certificate number on schedule B.	yyy	
6.1.2	c)	The visor and the face shield must be anti-scratch in accordance with ANSI Z 87.1 and or EN 166. Provide report/certificate number on schedule B.	yyy	
6.1.3	d)	The visor and face shield must be anti-fog in accordance with EN 166. Evidence provided? Provide report/certificate number on schedule B.	yyy	
6.2	3.3.1.2	Balaclava		
6.2.1	a)	Arc-rated material must be used for a balaclava, consistent with the construction, design, and protection of the garments.	Yes	
6.3	3.3.1.3	Hood		
6.3.1	c)	The arc rating shall be indelibly marked on the fabric of the hood.	Yes	
6.3.2	d)	When hoods are tested in accordance with ASTM F2178, they shall comply with the requirements of ASTM F1506 or IEC 61482-2. Provide report/certificate number on schedule B	yyy	
6.3.3	f)	The colour of the hood should be Navy blue Pantone 19_3920 or Royal blue Pantone 19_3955.	Navy blue Pantone 19_3920 or Royal blue Pantone 19_3955	

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

7	3.3.3	Minimum requirements for gloves		
7.1	a)	Hand protection shall be of arc rated material and tested in accordance with ASTM F2675/F2675M-13. Provide report/certificate number on schedule B	yyy	
8	3.3.4	Minimum requirements for rainwear		
8.1	a)	Rainwear shall comply with the requirements of ASTM F1891. Provide report/certificate number on schedule B	yyy	
8.2	b)	The rainwear shall be Navy blue or Royal blue in colour.	Navy blue or Royal blue	
8.3	c)	The rain suits shall be fitted with flame resistant or retardant strips on the circumference of both sleeves on the inner upper arm of the jacket, and with reflective strips on both legs above the knees. The reflective strips shall be visible in the day and at night.	Yes	
8.4	d)	The Zero Harm identification shall appear on the right side of the sleeve and shall be in accordance with Eskom's Corporate Identity.	Yes	
8.5	e)	The Eskom logo shall be silk-screened in accordance with Eskom's Corporate Identity, on the front and back.	Yes	
9	3.3.7	Minimum requirements for arc protective blanket to cover Switchboards		
9.1	a)	The arc rating of the arc protective blankets shall be tested in accordance with the test methods given in ASTM F2676. Provide report/certificate number on schedule B.	yyy	
9.2	d) i	The arc rating of the arc blanket	_____	
9.3	ii	The dimensions of the arc blanket	_____	
10	3.4	MARKING AND LABELLING		
10.1		The following information shall be included as a minimum on the label secured to the garment:		
10.2		The manufacturer's name or trade mark;	xxx	
10.3		Year of manufacture or garment serial	xxx	

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

		number for purpose of tracking.		
10.4		The size designation;	xxx	
10.5		The arc rating designation ATPV;	xxx	
10.6		The composition of the material in accordance with SANS 10235 or ASTM F 1506;	SANS 10235 or ASTM F 1506	
10.7		The care-labelling instructions in accordance with SANS 10011 or ASTM F1506;	SANS 10011 or ASTM F1506	
10.8		The service life;	xxx	
10.9		The washing control label if applicable.	xxx	
11	3.6	CARE AND MAINTENANCE OF PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT		
11.1		Provide Care and Maintenance instruction manual	Yes	

Table 2: Deviation Schedules

EXCLUSIONS, ADDITIONS AND DEVIATIONS		
NOTES:		
1. Any deviations/modifications/alternatives offered to the standard are listed below with reasons.		
2. No deviations/modifications/alternatives offered to the standard are recognised unless listed on this Schedule.		
3. If no deviations/modifications/alternatives are offered, this Schedule are marked N/A.		
Schedule Item no.	Item Description	Proposed deviation/Modification/Alternative

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

APPENDIX B: CHECK LIST ON COMPLIANCE UPON RECEIVING PPE

The check list below shall be used to verify compliance to the requirements of the standard upon receiving the PPE at site. The check list shall be used together with Technical Schedule A and B, as well Deviation Schedule.

Item	Description	Comply (Yes/No)	Checked by:	Date:
1	PPE category 2 minimum 12 cal/cm ² for the Jacket.			
2	PPE category 2 minimum 12 cal/cm ² for the trouser/pants.			
3	PPE category 4 minimum 50 cal/cm ² for the Jacket.			
4	PPE category 4 minimum 50 cal/cm ² for the trouser/pants.			
5	The Zero Harm identification shall appear on the right side sleeve on the top of the jacket and shall be in accordance with the Eskom Corporate Identity			
6	The Zero Harm identification shall appear on the right side sleeve on the top of the shirt and shall be in accordance with the Eskom Corporate Identity			
7	The Eskom logo shall appear on the left top side of the shirt/jacket in white and shall be in accordance with the Eskom Corporate Identity, below it shall be the ATPV value of the garment.			
8	The Eskom logo shall appear on the left top side of the jacket in white and shall be in accordance with the Eskom Corporate Identity.			
	Eskom logo, Zero Harm and ATPV designation font size of the letters shall be 20 mm in height and 3 mm in width.			
9	The arc rated jacket and pants shall be fitted with flame resistant/retardant reflective strips on the circumference of both sleeves. And the pants on both legs			
10	The arc rated jacket and pants are fitted with pockets as specified.			
11	The arc-rating shall be clearly shown on the garment. Size of the letters shall be 20 mm in height and 3 mm in width.			
12	The washing control label or service life.			
13	The care-labelling instructions in accordance			

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

	with SANS 10011 or ASTM F1506;			
14	Year of manufacture or garment serial number for purpose of tracking shall be included on the label			
15	The manufacturer's name or trademark shall be included on the label			
16	All labels shall be permanently secured so that they, including the marking, will outlast the service life of the garment.			
17	Confirm that goggles and Visor are anti scratch. Refer to type test report.			
18	Confirm that goggles and Visor are anti fog. Refer to type test report.			
19	Confirm that balaclava is made from arc rated material. Is material same as on the for the jacket?			
20	Confirm that arc rating is indelibly marked on the fabric of the hood			
21	Confirm that the colour of the hood is Navy blue Pantone 19_3920 or Royal blue Pantone 19_3955.			
22	Care and maintenance instruction manual accompanies the garments			

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.