

	Standard	Technology
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Title: **Specification for Outdoor Metal Oxide Surge Arresters Without Spark Gaps for System Voltages of 220kV and Above Standard**

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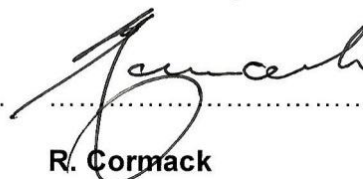


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1. INTRODUCTION

Surge arresters are installed in substations and transmission lines to limit overvoltages that may lead to flashovers and failure of substation HV terminal equipment. To ensure that surge arresters perform satisfactorily in service, they must be designed, constructed and tested according to specified technical requirements. This specification sets out Eskom's requirements for the design, manufacture, testing and delivery of non-linear metal oxide surge arresters without spark gaps for use on Eskom's transmission network.

2. SUPPORTING CLAUSES

2.1 SCOPE

This specification sets out Eskom's requirements for non-linear metal oxide surge arresters without spark gaps for outdoor installation in high voltage transmission systems of 220kV and above.

2.1.1 Purpose

The purpose of this specification is to ensure that outdoor metal oxide surge arresters for use in transmission substations are designed, manufactured, tested, supplied and delivered in accordance with Eskom's requirements to satisfy the desired technical performance.

2.1.2 Applicability

This specification shall apply to outdoor nonlinear, metal oxide surge arresters without spark gaps with system voltages of 220kV and above for installation in all Eskom Transmission substations.

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this specification shall apply the most recent edition of the documents listed below:

2.2.1 Normative

- [1] IEC 60099-4 - 2006: Surge Arresters - Part 4: Metal-oxide surge arresters without gaps for a.c. systems
- [2] IEC 60815: Guide for the selection of insulators in respect of polluted conditions
- [3] SANS 121: 2000/ISO 1461:1999: Hot dip galvanized coatings on fabricated iron and steel particles - Specifications and test methods

2.2.2 Informative

- [4] IEEE Std C62.11-1999: IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (> 1 kV)

2.3 DEFINITIONS

Definition	Description
Disconnecting device	A device for disconnecting an arrester from the system in the event of arrester failure, to prevent a persistent fault on the system and to give visible indication of the failed arrester (IEC 60099-4:2006)
Metal-oxide surge arrester without gaps	Arrester having non-linear metal-oxide resistors connected in series and/or in parallel without any integrated series or parallel spark gaps (IEC 60099-4:2006)

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Definition	Description
Polymer-housed arrester	Arrester using polymeric and composite material for housing, with fittings (IEC 60099-4:2006)
Porcelain-housed arrester	Arrester using porcelain as housing material, with fittings and sealing systems (IEC 60099-4:2006)
Type tests	Tests which are made upon completion of the development of a new arrester design to establish representative performance and to demonstrate compliance with the relevant standard (IEC 60099-4:2006)

2.3.1 Disclosure Classification

Controlled Disclosure: Controlled Disclosure to External Parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Standardization Organisation
kV	kilovolt
ps	microsecond
SANS	South African National Standard

2.5 ROLES AND RESPONSIBILITIES

None

2.6 PROCESS FOR MONITORING

None

2.7 RELATED/SUPPORTING DOCUMENTS

None

3. DOCUMENT SPECIFICATION FOR OUTDOOR METAL OXIDE SURGE ARRESTERS WITHOUT SPARK GAPS FOR SYSTEM VOLTAGES OF 220KV AND ABOVE

3.1 DESIGN

3.1.1 Electrical Requirements

The major electrical performance requirements are set out in schedule A. In addition to these requirements the following electrical characteristics should be attained.

- Arresters will be immune to the effects of airborne contamination on the external surfaces of the arrester housing.

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- b. In the event of arrester failure, its housing will not violently explode or shatter. The short circuit performance of the arrester will be as per IEC 60099-4 which permits acceptance of moulded design polymeric arresters that have no "pressure-relief" devices. All 220kV, 275kV and 400kV surge arresters are to be housed in polymeric insulation. It is acceptable for 765kV surge arresters to be housed in porcelain insulation.
- c. Station type arresters
If asked for in Schedule A, the arrester will be immune to the effects of line spray washing. A test report proving this will be submitted for Eskom's approval. For polymer-housed arresters, line washing should not be necessary.
- d. Transmission line arresters (TLA)
A disconnecting device will be provided to disconnect the earth lead in order to isolate the arrester electrically from the overhead line and to give a positive identification of the failed arrester.
- e. Electrical clearances
The surge arrester flashover distance will not be less than the minimum value stated in Schedule A.
Pro-rata arrester sections will provide a thermal replica of the complete arrester.
The guarantees of all electrical performance stated in Schedule B will be supported by evidence in the form of type test certificates.

3.1.2 Mechanical Requirements

3.1.2.1 Sealing

Sealing except where the external housing is directly moulded on the internal components

The sealing requirement is not applicable where the external housing is directly moulded in the internal component of the surge arrester.

Surge arresters will be permanently sealed. Dryness of internal components will be ensured by hermetic seals and moisture absorption devices e.g. silica gel.

An approved routine test of seal integrity will be carried out on every assembled arrester or arrester unit.

Technical details of the sealing arrangements and the routine seal test will be submitted.

3.1.2.2 Mounting

- a. Station-type arresters

All arresters will be isolated from the support structure by either an insulated base or support insulators. Support insulators may be constructed of epoxy or porcelain.

- b. Transmission line arresters (TLA)

All arresters are to be mounted in the suspension mode.

3.1.2.3 Terminals

Both main and earth-lead terminations will be suitable for the standard conductor of dimensions and materials specified in Schedule A.

Terminals will be of sufficient strength to withstand forces arising during installation and service. Such forces will not overstress the components of the arrester, particularly the sealing system.

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All line terminals shall be 38 mm in diameter for both station and transmission line arresters.

3.1.2.4 Finish

All ferrous components exposed to the atmosphere, excluding those of stainless steel and aluminium will be hot-dip galvanized in accordance with SANS 121. This includes earth terminals and holding-down bolts.

3.2 TESTS

3.2.1 Type Tests

Test certificates shall be provided to prove that the surge arresters comply with the provisions of IEC 60099-4:2006, Section 8 (for porcelain-housed arresters) or Section 10 (for polymer-housed arresters).

Should such evidence not be available, the relevant type tests will be performed and the costs thereof paid by the manufacturer or supplier.

Routine tests will be performed on the arresters in accordance with IEC 60099-4, clause 8.1

Transmission line surge arresters shall be tested in accordance with IEC 60099 4:2006 Annexure N to demonstrate their lightning impulse discharge capability.

3.2.2 Test Certificates

Single copies of test certificates covering type tests and, if required, any special tests will be submitted as soon as possible and at least three months before dispatch of the arresters.

3.2.3 Witnessing of Tests

Eskom reserves the right to appoint a representative to inspect the arresters at any stage of manufacture and to witness and sanction any tests.

If inspection or witnessing of tests is required, Eskom will advise the contractor who will then give fourteen days' notice of the date on which impending inspection or testing will take place.

3.3 MISCELLANEOUS

3.3.1 Design Changes

Any design change will be verified by tests wherever applicable and will be subject to Eskom's approval.

3.3.2 Arrester Characteristic

The manufacturer of the metal oxide surge arresters will furnish Eskom with the following characteristic data.

- a. V-I characteristics (protective level characteristics) at 8/20 ps, 30/60 ps and 1/2 ps front (steep current) impulses
- b. AC voltage-resistive current curves from 20°C to 180°C
- c. Clear unambiguous definitions of rated voltage, reference voltage and protective level
- d. Region of thermal stability
- e. Temporary overvoltage withstand capability curve

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3.3.3 Drawings (contractual)

Outline drawings, of which three hard copies and an electronic cope in PDF format, will be submitted for approval, will contain the following information as a minimum:

- a. Overall dimensions, including mounting details
- b. Details of main and earthing terminals and conductor clamping arrangements
- c. Mass of complete arrester, and if applicable, individual arrester sections
- d. Minimum electrical clearances
- e. Creepage distances
- f. Surge arrester rating plate details

Drawings will be submitted not later than three months from contract award date for approval. Once the drawings have been approved by Eskom, the contractor will be notified and supplied with an Eskom drawing number. The Eskom drawing number must then be incorporated in the approved drawing and sent back to Eskom for records.

3.3.4 Drawings submitted with Tender

Single copies of drawings will be submitted as part of the original tender showing the following details:

- a. Overall dimensions, including mounting details with drilling plan.
- b. Line conductor and earth conductor clamping arrangements.
- c. Line and earth terminal type details and physical dimensions.
- d. Minimum electrical clearances.
- e. Details of special items such as the disconnecting device or overpressure relief device.
- f. Insulating base type details and physical dimensions (where applicable).

3.3.5 Supporting Documentation

Single copies of the following documentation will be submitted as part of the original tender:

- a. Product catalogue.
- b. Transport, storage and installation procedure.
- c. Compliance to ISO 9001 and ISO 14001 certificates.

4. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
	This Document has been approved by TDAC ROD 13 February 2013

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5. REVISIONS

Date	Rev.	Compiler	Remarks
November 2012	0	K. Kleinhans	Draft document for Review created from TSP 41-363
June 2013	1	K. Kleinhans	Final Document for Publication

6. DEVELOPMENT TEAM

The following people were involved in the development of this document:

- Tony Auditore : Transmission Technology
- Kevin Kleinhans : Transmission Technology

7. ACKNOWLEDGEMENTS

- None

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APPENDIX A: TECHNICAL SCHEDULES – SYSTEM VOLTAGE: 765KV

Schedule A: Eskom's particular requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Description	Unit	Schedule A	Schedule B
1	Surge arrester identification.			
1.1	Manufacturer.		-	
1.2	Type designation of arrester.		-	
2	Site and service conditions.			
2.1	Electrical conditions of service.			
2.1.1	Nominal system voltage (U_n).	kV	765	
2.1.2	Maximum system voltage (U_m).	kV	800	
2.1.3	Basic insulation level of equipment to be protected.	kV(peak)	2100	
2.1.4	Frequency of supply.	Hz	50	
2.1.5	System earthing.		Effectively Earthed	
2.2	Site conditions of service.			
2.2.1	Altitude.	m	1800	
2.2.2	Maximum ambient temperature.	°C	40	
2.2.3	Minimum ambient temperature.	°C	-10	
2.2.4	Maximum diurnal variation.	°C	30	
2.2.5	Pollution condition as per IEC 60815	mm/kV	25	
2.2.6	Intensity of solar radiation.	(U_m)	1.1	
2.2.7	Spray washing.	kW/m ²	No	
3	Electrical characteristics.			
3.1	Arrester classification.			
3.1.1	IEC long duration class.		5	
3.1.2	Nominal discharge current.	kA _(peak)	20	
3.2	Arrester ratings.			
3.2.1	Continuous operating voltage.	kV	465	
3.2.2	Rated voltage.	kV	-	
3.2.3	Arrester power frequency reference voltage.	kV	-	
3.2.4	Nominal lightning discharge current.	kA _(peak)	20	
3.2.5	High current (4/10 μ s)	kA _(peak)	-	

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Item	Description	Unit	Schedule A	Schedule B
3.3	<i>Arrester steep-current impulse residual voltage with nominal discharge current front-times of:</i>			
3.3.1	1 μ s (not greater than).	kV _(peak)	-	
3.4	<i>Peak residual voltage for 8 x 20 μs current impulse of the following magnitudes:</i>			
3.4.1	10 kA (not greater than).	kV _(peak)	-	
3.4.2	20 kA (not greater than).	kV _(peak)	-	
3.4.3	30 kA (not greater than).	kV _(peak)	-	
3.5	<i>Operating duty test 1.</i>			
3.5.1	Arrester energy capability expressed as kilojoules per kV rated.	kJ/kV _r	-	
3.5.2	Total energy absorption capability.	kJ	-	
3.6	<i>Temporary overvoltage capability expressed as p.u. of U_m assuming maximum temperature and maximum energy absorbed just prior to application of overvoltage.</i>			
3.6.1	1.20 p.u. of U _m /√3.	ms	-	
3.6.2	1.40 p.u. of U _m /√3.	ms	-	
3.6.3	1.60 p.u. of U _m /√3.	ms	-	
3.7	<i>Surge arrester expected life at 40°C and maximum continuous operating voltage</i>	yrs	30	
3.8	<i>Arrester insulation withstand with internal parts removed (at sea level).</i>			
3.8.1	Lightning impulse (1,2/50 μ s) withstand level.	kV _(rms)	-	
3.8.2	Switching impulse (250/2500 μ s) withstand level.	kV _(peak)	-	
3.9	<i>External insulation dimensions.</i>			
3.9.1	Creepage distance over external insulation (not less than)			
	- 25 mm/kV.	mm	20125	
	- 31mm/kV.	mm	24 955	
3.9.2	External flashover distance (at least).	mm	5 500	

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3.10	<i>Radio influence voltage (RIV) at 1 MHz measured in accordance with NEMA publication 107, when energized at the following power voltages.</i>			
3.10.1	Maximum system voltage.	μV	-	
3.10.2	Arrester continuous operating voltage.	μV		
3.10.3	Arrester rated voltage.	μV	-	

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Item	Description	Unit	Schedule A	Schedule B
4	Arrester construction details.			
4.1	<i>Number of MOV elements in series per stack.</i>		-	
4.2	<i>Number of stacks in parallel.</i>			
4.3	<i>Dimensions of MOV elements.</i>			
4.3.1	Outside diameter of MOV element.	mm	-	
4.3.2	Inside diameter (if applicable).	mm	-	
4.3.3	Length (thickness).	mm	-	
4.4	<i>Pressure relief device installed according to IEC 99-4.</i>			
4.4.1	High current.	kA _(rms)	-	
4.4.2	Low current.	kA _(rms)	-	
4.5	<i>Filler medium of arrester (nitrogen, dry air, etc).</i>		-	
4.6	<i>Arrester mounting.</i>			
4.6.1	Overall height of line terminal above arrester base or mounting bracket.	mm	-	
4.6.2	Method of mounting — insulated or earthed.		insulated	
4.6.3	Diameter of voltage grading ring (if applicable).	mm	-	
4.6.4	Distance of grading ring from top of arrester.	mm	-	
4.6.5	Base insulator material type.		-	

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Item	Description	Unit	Schedule A	Schedule B
4.7	<i>Line terminals.</i>			
4.7.1	Line terminal with stem: - Diameter. - Minimum length. - Orientation.	mm mm	38 125 vertical	
4.7.2	Other type of line terminal to be suitable for clamping of the following conductor: - Material. - Type. - Cross section dimensions.	mm	- -	
4.8	<i>Earth terminal to be provided with clamp suitable for the following conductor:</i>			
4.8.1	Material.		-	
4.8.2	Type.		-	
4.8.3	Cross section dimensions.	mm	-	
5	Mechanical characteristics.			
5.1	<i>Minimum fracture moment.</i>	Nm	-	
5.2	<i>Maximum permissible horizontal force.</i>	N	-	
6	Miscellaneous.			
6.1	<i>Colour of housing.</i>		-	
6.2	<i>Type of housing (porcelain or silicon polymer).</i>		Porcelain	
6.3	<i>Mass of completely assembled single pole arrester.</i>	Kg	-	
6.4	<i>External diameter of arrester housing</i>	mm	-	
6.5	<i>Special arrester identification other than nameplate.</i>		-	
6.6	<i>Number of instruction/application manuals to be supplied.</i>		-	

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APPENDIX B: TECHNICAL SCHEDULES – SYSTEM VOLTAGE: 400KV

Schedule A: Eskom's particular requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Description	Unit	Schedule A	Schedule B
1	Surge arrester identification.			
1.1	Manufacturer.		-	
1.2	Type designation of arrester.		-	
2	Site and service conditions.			
2.1	Electrical conditions of service.			
2.1.1	Nominal system voltage (U_n).	kV	400	
2.1.2	Maximum system voltage (U_m).	kV	420	
2.1.3	Basic insulation level of equipment to be protected.	kV _(peak)	1 425	
2.1.4	Frequency of supply.	Hz	50	
2.1.5	System earthing.		Effectively Earthed	
2.2	Site conditions of service.			
2.2.1	Altitude.	m	1 000	
2.2.2	Maximum ambient temperature.	°C	40	
2.2.3	Minimum ambient temperature.	°C	-10	
2.2.4	Maximum diurnal variation.	°C	30	
2.2.5	Pollution condition as per IEC 60815	mm/kV	25	
2.2.6	Intensity of solar radiation.	(U_m)	1.1	
2.2.7	Live spray washing.	kW/m ²	No	
3	Electrical characteristics.			
3.1	Arrester classification.			
3.1.1	IEC long duration class.		4	
3.1.2	Nominal discharge current.	kA _(peak)	20	
3.2	Arrester ratings.			
3.2.1	Continuous operating voltage.	kV	245	
3.2.2	Rated voltage.	kV	-	
3.2.3	Arrester power frequency reference voltage.	kV	305	
3.2.4	Nominal lightning discharge current.	kA _(peak)	20	
3.2.5	High current (4/10 μ s)	kA _(peak)	100	

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Item	Description	Unit	Schedule A	Schedule B
3.3	<i>Arrester steep-current impulse residual voltage with nominal discharge current front-times of:</i>			
3.3.1	1 μ s (not greater than).	kV _(peak)	840	
3.4	<i>Peak residual voltage for 8 x 20 ps current impulse of the following magnitudes:</i>			
3.4.1	10 kA (not greater than).	kV _(peak)	-	
3.4.2	20 kA (not greater than).	kV _(peak)	-	
3.4.3	30 kA (not greater than).	kV _(peak)	-	

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Item	Description	Unit	Schedule A	Schedule B
3.5	<i>Operating duty test 1.</i>			
3.5.1	Arrester energy capability expressed as kilojoules per kV rated.	kJ/kV _r	-	
3.5.2	Total energy absorption capability.	kJ	-	
3.6	<i>Temporary overvoltage capability expressed as p. u. of Um assuming maximum temperature and maximum energy absorbed just prior to application of overvoltage.</i>			
3.6.1	1.20 p.u. of Um/√3.	ms	-	
3.6.2	1.40 p.u. of Um/√3.	ms	-	
3.6.3	1.60 p.u. of Um/√3.	ms		
3.7	<i>Surge arrester expected life at 40°C and maximum continuous operating voltage, longer or equal than.</i>	yrs	-	
3.8	<i>Arrester insulation withstand with internal parts removed (at sea level).</i>			
3.8.1	Lightning impulse (1,2/50μs) withstand level.	kV _(rms)	1 425	
3.8.2	Switching impulse (250/2500μs) withstand level.	kV _(peak)	1 050	
3.9	<i>External insulation dimensions.</i>			
3.9.1	Creepage distance over external insulation (not less than).		10 500	
	- 25mm/kV	mm	10 500	
	- 31mm/kV	mm	13 020	
3.9.2	External flashover distance (at least).	mm	3 200	
3.10	<i>Radio influence voltage (RIV) at 1 MHz measured in accordance with NEMA publication 107, when energized at the following power voltages.</i>			
3.10.1	Maximum system voltage.	μV	100	
3.10.2	Arrester continuous operating voltage.	μV	100	
3.10.3	Arrester rated voltage.	μV	250	

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Item	Description	Unit	Schedule A	Schedule B
4	Arrester construction details.			
4.1	Number of MOV elements in series per stack.	No	-	
4.2	Number of stacks in parallel.	No		
4.3	Dimensions of MOV elements.		-	
4.3.1	Outside diameter of MOV element.	mm	-	
4.3.2	Inside diameter (if applicable).	mm	-	
4.3.3	Length (thickness).	mm	-	
4.4	Pressure relief device installed according to IEC 99-4.			
4.4.1	High current.	kA _(rms)	-	
4.4.2	Low current.	kA _(rms)	-	
4.5	Filler medium of arrester (nitrogen, dry air, etc).			
4.6	Arrester mounting.			
4.6.1	Overall height of line terminal above arrester base or mounting bracket.	mm		
4.6.2	Method of mounting — insulated or earthed.		Insulated	
4.6.3	Diameter of voltage grading ring (if applicable).	mm	-	
4.6.4	Distance of grading ring from top of arrester.	mm	-	
4.5.6	Base insulator material type.			

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Item	Description	Unit	Schedule A	Schedule B
4.7	<i>Line terminals.</i>			
4.7.1	Line terminal with stem: - Diameter. - Minimum length. - Orientation.	mm mm	38 125 Vertical	
4.7.2	Other type of line terminal to be suitable for clamping of the following conductor: - Material. - Type. - Cross section dimensions.	mm	- —	
4.8	<i>Earth terminal to be provided with clamp suitable for the following conductor:</i>			
4.8.1	Material.		Copper	
4.8.2	Type.		Strap	
4.8.3	Cross section dimensions.	mm	50 x 3	
5	Mechanical characteristics.			
5.1	<i>Minimum fracture moment.</i>	Nm	-	
5.2	<i>Maximum permissible horizontal force.</i>	N	-	
6	Miscellaneous.			
6.1	<i>Colour of housing.</i>		-	
6.2	<i>Type of housing (porcelain or silicon polymer).</i>		Silicon polymer	
6.3	<i>Mass of completely assembled single pole arrester.</i>	Kg	-	
6.4	<i>External diameter of arrester housing</i>	mm	-	
6.5	<i>Special arrester identification other than nameplate.</i>		2	
6.6	<i>Number of instruction/application manuals to be supplied.</i>		-	

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APPENDIX C: TECHNICAL SCHEDULES – SYSTEM VOLTAGE: 275KV

Schedule A: Eskom's particular requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Description	Unit	Schedule A	Schedule B
1	Surge arrester identification.			
1.1	Manufacturer.		-	
1.2	Type designation of arrester.		-	
2	Site and service conditions.			
2.1	Electrical conditions of service.			
2.1.1	Nominal system voltage (U_n).	kV	275	
2.1.2	Maximum system voltage (U_m).	kV	300	
2.1.3	Basic insulation level of equipment to be protected.	kV _(peak)	1 050	
2.1.4	Frequency. of supply.	Hz	50	
2.1.5	System earthing.		Effectively Earthed	
2.2	Site conditions of service.			
2.2.1	Altitude.	m	Up to 1 800	
2.2.2	Maximum ambient temperature.	°C	40	
2.2.3	Minimum ambient temperature.	°C	-10	
2.2.4	Maximum diurnal variation.	°C	30	
2.2.5	Pollution condition as per IEC 60815	mm/kV	25	
2.2.6	Intensity of solar radiation.	(U_m)	1.1	
2.2.7	Live spray washing.	kW/m ²	No	
3	Electrical characteristics.			
3.1	Arrester classification.			
3.1.1	IEC long duration class.		3	
3.1.2	Nominal discharge current.	kV _(peak)	10	
3.2	Arrester ratings.			
3.2.1	Continuous operating voltage.	kV	180	
3.2.2	Rated voltage.	kV	-	
3.2.3	Arrester power frequency reference	kV	228	
3.2.4	Nominal lightning discharge current.	kV _(peak)	10	
3.2.5	High current (4/10 μ s)	kV _(peak)	100	

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Item	Description	Unit	Schedule A	Schedule B
3.3	<i>Arrester steep-current impulse residual voltage with nominal discharge current front-times of:</i>			
3.3.1	1 μ s (not greater than).	kV _(peak)	612	
3.4	<i>Peak residual voltage for 8 x 20 μs current impulse of the following magnitudes:</i>			
3.4.1	10 kA (not greater than).	kV _(peak)	560	
3.4.2	20 kA (not greater than).	kV _(peak)	620	
3.4.3	30 kA (not greater than).	kV _(peak)	-	

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Item	Description	Unit	Schedule A	Schedule B
3.5	<i>Operating duty test 1.</i>			
3.5.1	Arrester energy capability expressed as kilojoules per kV rated.	kJ/kV_r	7,20	
3.5.2	Total energy absorption capability.	kJ	-	
3.6	<i>Temporary overvoltage capability expressed as p.u. of U_m assuming maximum temperature and maximum energy absorbed just prior to application of overvoltage.</i>			
3.6.1	1.20 p.u. of $U_m/\sqrt{3}$.	ms	-	
3.6.2	1.40 p.u. of $U_m/\sqrt{3}$.	ms	-	
3.6.3	1.60 p.u. of $U_m/\sqrt{3}$.	ms	-	
3.7	<i>Surge arrester expected life at 40°C and maximum continuous operating voltage, longer or equal than.</i>	yrs	-	
3.8	<i>Arrester insulation withstand with internal parts removed (at sea level).</i>			
3.8.1	Lightning impulse (1,2/50ps) withstand level.	$\text{kV}_{(\text{rms})}$	1 050	
3.8.2	Switching impulse (250/2500ps) withstand level.	$\text{kV}_{(\text{peak})}$	850	
3.9	<i>External insulation dimensions,</i>			
3.9.1	Creepage distance over external insulation (not less than).			
		mm	7 500	
	- 25 mm/kV.	mm	9 300	
	- 31mm/kV.			
3.9.2	External flashover distance (phase to earth).	mm	2 350	
3.10	<i>Radio influence voltage (RIV) at 1 MHz measured in accordance with NEMA publication 107, when energized at the following power voltages.</i>			
3.10.1	Maximum system voltage.	μV	100	
3.10.2	Arrester continuous operating voltage.	μV	100	
3.10.3	Arrester rated voltage.	μV	250	

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Item	Description	Unit	Schedule A	Schedule B
4	Arrester construction details.			
4.1	<i>Number of MOV elements in series per stack.</i>		-	
4.2	<i>Number of stacks in parallel.</i>		-	
4.3	<i>Dimensions of MOV elements.</i>			
4.3.1	Outside diameter of MOV element	mm	-	
4.3.2	Inside diameter (if applicable).	mm	-	
4.3.3	Length (thickness).	mm	-	
4.4	<i>Pressure relief device installed according to IEC 99-4 (where applicable).</i>			
4.4.1	High current.	kA _(rms)	-	
4.4.2	Low current.	kA _(rms)	-	
4.5	<i>Filler medium of arrester (nitrogen, dry air, etc).</i>		-	
4.6	<i>Arrester mounting.</i>			
4.6.1	Overall height of line terminal above arrester base or mounting bracket.	mm	-	
4.6.2	Method of mounting — insulated or earthed.		Insulated	
4.6.3	Diameter of voltage grading ring (if applicable).	mm	-	
4.6.4	Distance of grading ring from top of arrester.	mm	-	
4.6.5	Base insulator material type.			

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Item	Description	Unit	Schedule A	Schedule B
4.7	<i>Line terminals.</i>			
4.7.1	Line terminal with stem: - Diameter. - Minimum length. - Orientation.	mm mm	38 125 Vertical	
4.7.2	Other type of line terminal to be suitable for clamping of the following conductor: - Material. - Type. - Cross section dimensions.	mm	- -	
4.8	<i>Earth terminal to be provided with clamp suitable for the following conductor:</i>			
4.8.1	Material.		Copper	
4.8.2	Type.		Strap	
4.8.3	Cross section dimensions.	mm	50 x 3	
5	Mechanical characteristics.			
5.1	<i>Minimum fracture moment.</i>	Nm		
5.2	<i>Maximum permissible horizontal force.</i>	N		
6	Miscellaneous.			
6.1	<i>Colour of housing.</i>		-	
6.2	<i>Type of housing (porcelain or silicon polymer).</i>		Silicon Polymer	
6.3	<i>Mass of completely assembled single pole arrester.</i>	Kg	-	
6.4	<i>External diameter of arrester housing</i>	mm	-	
6.5	<i>Special arrester identification other than nameplate.</i>		-	
6.6	<i>Number of instruction/application manuals to be supplied.</i>		2	

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APPENDIX D: TECHNICAL SCHEDULES – SYSTEM VOLTAGE: 220KV

Schedule A: Eskom's particular requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Description	Unit	Schedule A	Schedule B
1	Surge arrester identification.			
1.1	Manufacturer.		-	
1.2	Type designation of arrester.		-	
2	Site and service conditions.			
2.1	Electrical conditions of service.			
2.1.1	Nominal system voltage (U_n).	kV	220	
2.1.2	Maximum system voltage (U_m).	kV	242	
2.1.3	Basic insulation level of equipment to be protected.	kA _(peak)	825	
2.1.4	Frequency of supply.	Hz	50	
2.1.5	System earthing.		Effectively Earthed	
2.2	Site conditions of service.			
2.2.1	Altitude.	m	1000	
2.2.2	Maximum ambient temperature.	°C	40	
2.2.3	Minimum ambient temperature.	°C	-10	
2.2.4	Maximum diurnal variation.	°C	30	
2.2.5	Pollution condition as per IEC 60815	mm/kV	25	
2.2.6	Intensity of solar radiation.	(U_m)	1.1	
2.2.7	Live spray washing.	kW/m ²	No	
3	Electrical characteristics.			
3.1	Arrester classification.			
3.1.1	IEC long duration class.		3	
3.1.2	Nominal discharge current.	kA _(peak)	10	
3.2	Arrester ratings.			
3.2.1	Continuous operating voltage.	kV	154	
3.2.2	Rated voltage.	kV	-	
3.2.3	Arrester power frequency reference voltage.	kV	192	
3.2.4	Nominal lightning discharge current.	kA _(peak)	10	
3.2.5	High current (4/10 μ s)	kA _(peak)	100	

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Item	Description	Unit	Schedule A	Schedule B
3.3	<i>Arrester steep-current impulse residual voltage with nominal discharge current front-times of:</i>			
3.3.1	1 μ s (not greater than).	kV _(peak)	-	
3.4	<i>Peak residual voltage for 8 x 20 μs current impulse of the following magnitudes:</i>			
3.4.1	10 kA (not greater than).	kV _(peak)		
3.4.2	20 kA (not greater than).	kV _(peak)	-	
3.4.3	30 kA (not greater than).	kV _(peak)	-	

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Item	Description	Unit	Schedule A	Schedule B
3.5	<i>Operating duty test 1.</i>			
3.5.1	Arrester energy capability expressed as kilojoules per kV rated.	kJ/kV_r	-	
3.5.2	Total energy absorption capability.	kJ	-	
3.6	<i>Temporary overvoltage capability expressed as p.u. of U_m assuming maximum temperature and maximum energy absorbed just prior to application of overvoltage.</i>			
3.6.1	1.20 p.u. of $U_m/\sqrt{3}$.	ms	-	
3.6.2	1.40 p.u. of $U_m/\sqrt{3}$.	ms	-	
3.6.3	1.60 p.u. of $U_m/\sqrt{3}$.	ms	-	
3.7	<i>Surge arrester expected life at 40°C and maximum continuous operating voltage, longer or equal than.</i>	yrs	-	
3.8	<i>Arrester insulation withstand with internal parts removed (at sea level).</i>			
3.8.1	Lightning impulse (1,2/50 μs) withstand level.	$\text{kV}_{(\text{rms})}$	-	
3.8.2	Switching impulse (250/2500 μs) withstand level.	$\text{kV}(\text{peak})$	-	
3.9	<i>External insulation dimensions.</i>			
3.9.1	Creepage distance over external insulation (not less than).			
	- 25 mm/kV.	mm	6 050	
	- 31mm/kV.	mm	7 502	
3.9.2	External flashover distance (phase to earth).	mm	1 850	
3.10	<i>Radio influence voltage (R1V) at 1 MHz measured in accordance with NEMA publication 107, when energized at the following power voltages.</i>			
3.10.1	Maximum system voltage.	μV	100	
3.10.2	Arrester continuous operating voltage.	μV	100	
3.10.3	Arrester rated voltage.	μV	250	

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Item	Description	Unit	Schedule A	Schedule B
4	Arrester construction details.			
4.1	<i>Number of MOV elements in series per stack.</i>	No	-	
4.2	<i>Number of stacks in parallel,</i>	No	-	
4.3	<i>Dimensions of MOV elements.</i>			
4.3.1	Outside diameter of MOV element	mm	-	
4.3.2	Inside diameter (if applicable).	mm	-	
4.3.3	Length (thickness).	mm		
4.4	<i>Pressure relief device installed according IEC 99-4.</i>			
4.4.1	High current.	kA _(rms)		
4.4.2	Low current.	kA _(rms)	-	
4.5	<i>Filler medium of arrester (nitrogen, dry air, etc).</i>		-	
4.6	<i>Arrester mounting.</i>			
4.6.1	Overall height of line terminal above arrester base or mounting bracket.	mm	-	
4.6.2	Method of mounting — insulated or earthed		Insulated	
4.6.3	Diameter of voltage grading ring (if applicable).	mm	-	
4.6.4	Distance of grading ring from top of arrester.	mm		
4.6.5	Base insulator material type.			

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Item	Description	Unit	Schedule A	Schedule B
4.7	<i>Line terminals.</i>			
4.7.1	Line terminal with stem: <ul style="list-style-type: none"> - Diameter. - Minimum length. - Orientation. 	mm mm	38 125 Vertical	
4.7.2	Other type of line terminal to be suitable for clamping of the following conductor: <ul style="list-style-type: none"> - Material. - Type. - Cross section dimensions. 	mm	- - —	
4.8	Earth terminal to be provided with clamp suitable for the following conductor:			
4.8.1	Material		Copper	
4.8.2	Type.		Strap	
4.8.3	Cross section dimensions.	mm	50 x 3	
5	Mechanical characteristics.			
5.1	<i>Minimum fracture moment.</i>	Nm	-	
5.2	<i>Maximum permissible horizontal force.</i>	N	-	
6	Miscellaneous.			
6.1	<i>Colour of housing.</i>		-	
6.2	<i>Type of housing (porcelain or silicon polymer).</i>		Silicon Polymer	
6.3	<i>Mass of completely assembled single pole arrester.</i>	Kg		
6.4	<i>External diameter of arrester housing</i>	mm		
6.5	<i>Special arrester identification other than nameplate.</i>			
6.6	<i>Number of instruction/application manuals to be supplied.</i>		2	

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APPENDIX E: DEVIATION TO SPECIFICATION SCHEDULE

Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified by Eskom.		
Item	Clause	Proposed deviation

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