TRANSNET freight rail

TECHNOLOGY MANAGEMENT.

SPECIFICATION.

REQUIREMENTS FOR METAL OXIDE SURGE ARRESTERS WITHOUT GAPS FOR TRACTION AND POWER DISTRIBUTION SUBSTATIONS IN ACCORDANCE WITH SANS 60099-4

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1.0 SCOPE

This documents presents information and requirements for metal oxide surge arresters of the station class to be installed at Transnet Freight Rail's traction substations and distribution substations.

2.0 INFORMATION ON SYSTEM

2.1 Nominal frequency is 50 HZ.

2.2 Maximum duration of the earth fault is less than 1 second (Solidly earthed).

2.3 Short-circuit current of the system at the arrester location is lower than 10 kA.

2.4 Transnet Freight Rail's traction substations and power distributions systems are considered to be effectively earthed.

2.5 An earth fault factor equal to $0.8x\sqrt{3}$ for solidly earthed neutral systems was used to calculate the ratings of the surge arresters which will be suitable for the different nominal r.m.s voltage systems supplying Transnet Freight Rail's traction substations and distributions substations.

3.0 STANDARDS

3.1 Unless otherwise specified all materials and equipment supplied shall comply with the current edition of the relevant SANS or Transnet Freight Rail's publication where applicable.

3.2 The following publications are referred to in this specification:

3.2.1 SOUTH AFRICAN NATIONAL STANDARDS

SANS 1019:	Standard voltages, currents and insulating levels for electrical supply.

4.0 INFORMATION ON SERVICE CONDITIONS

4.1 NORMAL CONDITIONS

See conditions in clause 4.4.1 SANS 60099-4

4.2 ABNORMAL CONDITIONS

The surge arrester shall be designed for the following ambient conditions:

Altitude:	0 to 1800m above sea level
Ambient temperature:	minus10 °C to plus 45 °C
Relative humidity:	10% to 90%.
Atmosphere:	Heavy polluted environment: salt laden, industrial and locomotive fumes, and severe dust conditions.

5.0 INSULATION LEVELS

INSULATION LEVELS

For the medium and high voltage nominal r.m.s voltage systems on Transnet Freight Rail the recommended Insulation levels is tabled in table 1 below.

Highest phase-to-phase r.m.s voltage for equipment. (Um)	Nominal system r.m.s. voltage. (U_n)	Rated lightning impulse withstand voltage peak.	Rated short duration power- frequency withstand r.m.s voltage.
7,2 kV	6,6 kV	75 kV	22 kV
12 kV	11 kV	95 kV	28 kV
24 kV	22 kV	150kV	50 kV
36 kV	33 kV	200 kV	70 kV
52 kV	44 kV	250 kV	95 kV
72,5 kV	66 kV	350 kV	140 kV
100 kV	88kV	380 kV 450 kV	150 kV 185 kV
145 kV	132 kV	550 kV 650 kV	230 kV 275 kV
245 kV	220 kV	850 kV 950 kV	360 kV 395 kV
Insulation levels for highest voltage for equipment U_m < 100 kV are based on an earth fault factor equal to $\sqrt{3}$ and for U_m > 100 kV an earth fault factor equal to $0,8\sqrt{3}$. Where more than one insulation level is given per voltage system, the higher level is appropriate for equipment where the earth fault factor is greater than 1,4.			

TABLE 1: Standard Voltages and insulation levels in accordance with SANS 1019:2008 [1]

6.0. INFORMATION ON THE ARRESTER DUTY

6.1 Selection of surge arresters for the traction substations and distribution substations shall be in accordance with tables No's 2 and shall not compromise the recommended impulse levels as shown in table No 1

6.2 The arrester will be connected between phase and earth.

6.3 The equipment, which will be protected, is:

- Transformer directly connected to line via overhead conductors.
- Rectifier units (Diodes, Capacitors, etc.).

7.0 SCHEDULE OF SURGE ARRESTER RATINGS FOR EFFECTIVELY EARTHED SYSTEMS.

Table 2 shown below is representative of the parameters of surge arresters employed for protection. Minor deviations from the table are permissible but information concerning these deviations must be supplied to Technology Management for acceptance.

TABLE 2

Nominal system r.m.s. voltage	6,6 kV	11kV	22 kV	33 kV	44 kV	66 kV	88 kV	132 kV	220 kV
Rated voltage of surge arrester. Ur	6,0 kV	12 kV	21kV	36 kV	42 kV	60 kV	84 kV	120 kV	198 kV
Continuous operating voltage of surge arrester Uc	4,8 kV	9.6 kV	16.8 kV	28.8 kV	33.6 kV	48 kV	67 kV	96 kV	158 kV
Nominal discharge current (8/20 μ s)	10 kA	10 kA	10 kA	10 kA	10 kA	10 kA	10 kA	10 kA	10 kA
High current (4/10μs)	100 kA	100 kA	100 kA	100 kA	100 kA	100 kA	100 kA	100 kA	100 kA
Line discharge class	2	2	2	2	2	2	2	2	3
Pressure relief capability (0.2s)	40 kA	40 kA	40 kA	40 kA	40 kA	40 kA	40kA	40 kA	63kA
Temporary overvoltage (TOV) prestressed acc to IEC 99-4 for duration of 1 second	6,9 kV	13.8 kV	24.1kV	41.4kV	48.3kV	69kV	96kV	138kV	228 kV
Temporary overvoltage (TOV) prestressed acc to IEC 99-4 for duration of 10 seconds	6,5 kV	13.0 kV	22.8 kV	39.2 kV	45.7 kV	65 kV	91kV	130 kV	214kV
Residual voltage at steep current impulse (1/2 μ s) 10kA	17,6 kV	35.1kV	61.4 kV	105.3 kV	123 kV	176 kV	246 kV	351kV	518 kV
Residual voltage at lightning current impulse (8/20 μ s) 10kA	16 kV	31.9 kV	55.9 kV	95.8 kV	111.8kV	160 kV	223 kV	319 kV	475 kV
Residual voltage at switching current impulse (30/70 μ s)500A	12,9 kV	25.8 kV	45.2 kV	77.5 kV	90.8 kV	129 kV	181 kV	258 kV	392 kV

7.1 For the 25 kV and 50kV single phase ac traction systems the ac high voltage circuit breakers shall be designed to the following nominal system phase to phase r.m.s voltages and withstand insulation levels:

- For the 25 kV (phase to earth) ac traction systems the ac high voltage circuit breakers current transformer shall be rated for a nominal system phase to phase r.m.s voltage of at least 44 kV and designed to withstand the required insulation level for that nominal system voltage.
- For the 50 kV (phase to earth) ac traction systems the ac high voltage circuit breakers shall be rated for a nominal system phase to phase r.m.s voltage of at least 88 kV and designed to withstand the required insulation level for that nominal system voltage.

8.0 REQUIREMENTS

8.1 The manufacturer shall provide a routine test report for each arrester in accordance to SANS 60099-4 clause 8.1 a, b and c.

8.2 To verify the seal integrity the manufacturer shall indicate the leakage rate of the arrester (SANS 60094-4 clause 8.1.d) and what type of leakage test method has been used. The Integrated Helium Mass Spectrometer or the Membrane method is the preferred method.

8.3 The tenderer shall provide the information as per SANS 60099-4, Annexure G, Clause G2.

8.4 Nameplate data in accordance with clause 3.1 of SANS 60099-4 shall be fitted to each arrester.

8.5 If a polymer type of arrester is presented it is preferred that the housing will consist of Fibre-reinforced Resin tube with a non-tracking Silicon shed which is UV protected.

8.6 The sealing test is only required for arresters with enclosed gas volumes and separate sealing systems.

9.0 BIBLIOGRAPHY

[1] SANS 1019: 2008. Edition 2.5

END

SCHEDULE OF REQUIREMENTS

SURGE ARRESTER FOR SUBSTATIONS

1.0 Arresters required for substation: _____

2.0 Quantity required: _____

3.0 Nominal system voltage: _____

4.0. Surge arresters to be fitted with insulation bases: yes / no.

5.0. Surge counters required for the surge arresters yes / no

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TECHNOLOGY MANAGEMENT

SPECIFICATION

ADDENDUM TO BBB 0845: FOR REQUIREMENTS FOR SURGE ARRESTORS BETWEEN ANTRA AND MOOLMAN TRACTION SUBSTATION

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1. SCOPE

This addendum specification describes Transnet's requirements for metal surge arrestors of the heavy duty station type to be installed at Antra, Overvaal, Iswepe, Wildrandt and Moolman 25 kV AC traction substations on the high voltage supply side of the traction transformers. All sections of BBB 0845 are applicable except where stated otherwise in this document.

2. TECHNICAL REQUIREMENTS

2.1 Apart for the technical requirements as per specification BBB0845 the following requirements as per Table 2 are for above substations only.

2.1.1 Nominal system RMS voltage is **88 kV**.

2.1.2 The Rated voltage (Ur) of the surge arrestor shall be **96 kV**.

2.1.3 Continuous operating voltage (Uc) for the surge arrestor shall be **77 kV**.

2.1.4 Nominal discharge current (8/20 µs) shall be **20 kA**.

2.1.5 Line discharge class shall be **4**.

2.1.6 Temporary overvoltage (TOV) pre-stressed according to SANS 60099-4 for a duration of 1 sec shall be at least **108** kV.

2.1.7 Temporary overvoltage (TOV) pre-stressed according to SANS 60099-4 for a duration of 10 sec shall be at least **101** kV.

2.1.8 Surge arrestor shall be of a single unit construction.

2.1.9 Residual voltage at steep current impulse (1/2 µs) 10 kA shall be a maximum of **250 kV**.

2.1.10 Residual voltage at lightning current impulse (8/20 µs) 20 kA shall be maximum of **250 kV**.

2.1.11 Residual Voltage at switching current impulse (30/70 µs) 500 A shall be a maximum of **187 kV**.

2.2 A surge counter with leakage current meter and 3 mounting insulators must be quoted for separately.

2.2.1 Each high voltage surge arrester must be fitted with surge counters in the Antra to Moolman section.

END