TENAGA NASIONAL
Engineering Services
11th Floor, Wisma TNB
No. 19, Jalan Timur
46200 Petaling Jaya
Selangor Darul Ehsan
Tel: 03-79679000, Fax: 03-79600324

TECHNICAL SPECIFICATION

10kA POLYMERIC METAL OXIDE GAPLESS SURGE ARRESTER (STATION LOW) FOR USE IN 33kV OVERHEAD LINE SYSTEMS

Specification No.	KEJ05285:2020	Revision No.	1
Prepared by	Ir. Mohd Faris bin Ariffin Specialist (Overhead Line Systems Design & Diagnostics) Engineering Services Asset Management Department TNB, Distribution Network Division		
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(WAN NAZMY BIN WAN MAHMOOD)
Head (Asset Management)
Distribution Network, TNB

1.0 SCOPE

1.1 This specification covers the design, construction, electrical characteristics, and test requirements for 10 kA Polymeric Metal Oxide Gapless Surge Arrester (Station Low) that is intended to be used in the 33kV Overhead Line Systems.

1.2 The surge arrester shall be suitable for outdoor use in the Tropical Zone with relative humidity of approximately 95%, heavy rainfall, ambient temperature of 28^0C to 45^0C, solar radiation of 1200 W/m^2 and an average of isoceraunic level of approximately 200 thunder-days per annum. The operational altitude is preferably up to 1800 meters from sea level.

2.0 FUNCTIONS

2.1 The surge arrester shall be designed for outdoor service conditions abovementioned and shall be used as an accessory for TNB 33kV overhead line systems.

2.2 The surge arrester shall be capable of providing the 33kV overhead line equipment and installations with protection against lightning and shall itself be able to withstand voltage surges due to lightning.

3.0 SYSTEM PARAMETERS

The surge arrester shall be designed for continuous operation as specified under the following conditions: -

No	Conditions	33 kV
i.	Rated Frequency	50 Hz
ii.	Number of Phases	3
iii.	Nominal Voltage	33 kV (rms)
iv.	Rated Voltage	36 kV (rms)
v.	Prospective Short-Circuit Current	$I_{sc} \geq 25$ kA
vi.	Grounding System	Neutral Earthing Resistor

4.0 CONFORMITY WITH STANDARDS

4.1 Unless otherwise specified, the specification for the 10kA Polymeric Metal Oxide Gapless Surge Arrester (Station Low) shall include but is not limited to the following standards as reference and for compliance together with all current amendments: -

a. IEC 60099-4 (2014) : Surge Arresters – Part 4: Metal oxide surge arresters without gaps for a.c. systems

b. IEC 60099-5 (2018) : Surge Arresters – Part 5: Selection and application recommendations

c. IEC 61109 (2008) : Insulators for overhead lines - Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1000 V - Definitions, test methods and acceptance criteria

4.2 Other internationally recognized standards that are compatible to the abovementioned standards can be considered provided that an English version of such standards shall be submitted to TNB for further reference.

5.0 TECHNICAL REQUIREMENT

No	Item	Requirement
1.	Arrester Classification	Station Low (SL)
2.	Standard Nominal Discharge Current (8/20μs)	I_n = 10 kA_{peak}
3.	High Current Impulse Withstand (4/10μs)	I_{hc} = 100 kA_{peak}
4.	Thermal Energy Rating (W_{th}) @ U_r	≥ 4.0 kJ/kV
5.	Repetitive Charge Transfer Rating (Q_{rs})	≥ 1.0 Coulombs
6.	Nominal Voltage; kV	33.0
7.	Rated Voltage; kV (U_r)	36.0
8.	Maximum Continuous Operating Voltage (MCOV); kV (U_c)	28.8
9.	Maximum Residual Voltage @ I_n	≤ 127.5
10.	Insulation Withstand Voltage	
a.	Lightning Impulse Withstand Voltage (Dry); kV_{peak}	170
b.	Power Frequency Withstand Voltage (Wet); kV	≥ 70
11.	Minimum Creepage Distance; mm	≥ 720
12.	Minimum Cantilever Strength; Nm	≥ 250

6.0 DESIGN AND CONSTRUCTION

6.1 The surge arrester shall be connected between phase and earth across distribution medium voltage overhead line equipment and switchgears such as pole top transformers, automatic circuit reclosers, and load break switches to protect these equipment and switchgears against voltage surges due to lightning.

6.2 The surge arrester metal oxide blocks shall be housed in a hermetically sealed silicone housing to prevent ingress of moisture.

6.3 The design of the silicone-housed surge arrester shall be so designed to minimize accumulation of contaminant and shall be such that the stresses due to expansion and contraction in any part of the silicone housing shall not lead to deterioration.

6.4 The construction of the surge arrester housing shall also be so designed such that the silicone is directly molded onto the metal oxide blocks to ensure that no void is present between the metal oxide blocks and the silicone rubber housing to avoid any formation of air bubble or allow moisture ingress.

6.5 The surge arrester shall be provided with a disconnecting device without any explosive cartridge to ensure that damaged or failed surge arrester in service is isolated from the system to prevent it from causing persistent fault to the system. The surge arrester disconnector shall also be so designed such that it will be able to give a visible indication that the surge arrester has damaged or failed.

6.6 The surge arrester shall come complete with the following accessories to ensure secured and safe mounting on the overhead line installations:

6.6.1 Line terminal clamps of suitable material to connect both aluminum and copper conductors;

6.6.2 Earth connection lead or earthing terminal clamps suitable to connect 50mm^2 copper conductor;

6.6.3 Both line terminal and earthing terminal studs shall be of M12 size;

6.6.4 Mounting clamps of mechanically strong and corrosion-resistant material. Iron or steel parts shall be hot-dipped galvanized;

6.6.5 Insulating bracket that is robust to be used for mounting the surge arrester to the overhead line system installations;

6.6.6 Insulating cover as per TNB Technical Specification **KEJ08237:2013 Rev. 1** – *Insulating Covers for 33kV Pole-Mounted Substations* for the surge arrester to protect its exposed terminals from direct contact with animal or vegetation encroachment

6.7 The surge arrester shall be free from sharp edges, burrs, flash, or surface projections that could cause damage to the conductor or inflict injury to the installer or user. It shall also be so designed that in normal use its performance is reliable and without danger to persons or surroundings.

6.8 Bidders may propose alternative designs based on the conceptual design described in paragraph 6.1 - 6.7 and the functional requirements outlined in paragraph 2.0 above. Relevant design drawings and documentation complete with the dimensions and descriptions shall be submitted.

6.9 The surge arrester shall be manufactured according to and its safety features and operations shall be tested to the standards mentioned in Clause 4.0 of this specification.

6.10 The surge arrester shall have adequate electrical and mechanical strength for the functions mentioned in Clause 2.0 of this specification and shall comply with the relevant standards as mentioned in Clause 4.0 of this specification.

7.0 MARKING AND IDENTIFICATION

The markings on the surge arrester shall comply with Clause 4.1 of IEC 60099-4 and shall be legible and durable containing the following minimum information: -

- Manufacturer's Name and Date of Manufacture
- Make and Model No.
- Arrester Classification
- Maximum Continuous Operating Voltage (MCOV); U_c
- Rated Voltage; U_r
- Rated Frequency; Hz

- Nominal Discharge Current; I_n
- Repetitive Charge Transfer Rating; Q_{rs}
- The Acronym "TNB" & TNB Contract Number
- Reference Standard i.e. IEC 60099-4

8.0 INSPECTION AND TESTING

8.1 General Requirements

8.1.1 It is the responsibility of the manufacturer to ensure that the product is inspected and tested at all stages of manufacturing in accordance with the requirements as stipulated in this specification.

8.1.2 The approval or passing of any such tests and inspections shall not prejudice the right of TNB to reject the product if it does not comply with this specification when installed or if it does not give complete satisfaction in service. This condition shall apply only if the causes of the above-mentioned situations are due to any deficiency or wrong action on the part of the manufacturer towards the fulfillment of the requirements of this specification.

8.1.3 The manufacturer shall allow the representative of TNB or its appointed Quality Agents access to all production facilities necessary for the manufacture of this product, at all reasonable times. The manufacturer is responsible to maintain all Quality and Test records for a minimum period of five (5) years. TNB and / or its appointed agents reserve the right to inspect these records as and when deemed necessary.

8.1.4 During such inspection, any corrective actions necessary shall be complied with within the scope of this specification

8.1.5 The tests shall be carried out in accordance with the standards mentioned in Clause 4.0 above and other related amendments, and any additional requirements as stated in this specification.

8.2 Type Test

8.2.1 The product shall have successfully passed the type tests for polymer-housed surge arrester in accordance with IEC 60099-4 (2014) and its other related amendments, if any:

a. Insulation withstand tests (Clause 10.8.2) ~ *switching impulse test not required*
b. Residual voltage tests (Clause 10.8.3)
c. Test to verify long term stability under continuous operating voltage (Clause 10.8.4)
d. Test to verify the repetitive charge transfer rating, Q_{rs} (Clause 10.8.5)
e. Heat dissipation behavior of test sample (Clause 10.8.6)
f. Operating duty tests (Clause 10.8.7)
g. Power frequency voltage-versus-time test (Clause 10.8.8)
h. Tests of arrester disconnector (Clause 10.8.9)
i. Short-circuit tests (Clause 10.8.10)
j. Test of the bending moment (Clause 10.8.11)
k. Weather ageing test (Clause 10.8.17)

8.2.2 In the event that modifications to the design of the product are made in which in the opinion of TNB that it will affect the performance of the product, the relevant type tests shall be repeated at the expense of the manufacturer. TNB engineers or its appointed Quality Agent shall select samples for the purpose of these tests.

8.2.3 The type tests as mentioned in Clause 8.2.1 above are to be conducted at any national or international independent laboratory accredited to ISO/IEC 17025 by the National Accreditation Body. The tests to be conducted shall be within the scope of accreditation of the laboratory and shall cover the appropriate capacity limit for the specified tests.

8.2.4 TNB shall reserve the rights to witness the conduct of the said tests if deemed necessary through its engineers or appointed representatives.

8.3 Routine Tests

8.3.1 Routine tests shall be carried out by the manufacturer on all products in the finished state or, where appropriate, during the manufacturing processes. The routine tests that shall be made on the products as per Clause 9.1 of IEC 60099-4 (2014) are: -

a. Measurement of reference voltage, U_{ref} (Clause 9.1.a)
b. Residual voltage test (Clause 9.1.b)
c. Internal partial discharge test (Clause 9.1.c)

8.4 Product Inspection / Factory Acceptance Test

8.4.1 The manufacturer shall carry out product inspection / factory acceptance tests on sample of products in the finished state. The sampling tests that shall be made on the products as per Clause 9.2 of IEC 60099-4 (2014) are: -

a. Visual inspection on markings
b. Physical and visual verification of the dimensions and construction
c. Measurement of power-frequency voltage on the arrester at the reference current (Clause 9.2.1.a)
d. Lightning impulse residual voltage on the arrester at nominal discharge current if possible or at a current value chosen according to Clause 8.3 of IEC 60099-4 (2014) (Clause 9.2.1.b)
e. Internal partial discharge test (Clause 9.2.1.c)
f. Bending moment and tensile load tests (Clause 9.2.1.d)

8.4.2 The sampling rate for the product inspection / factory acceptance test shall be referred to the tender document.

9.0 TECHNICAL DATA

Technical drawings and technical data pertaining to the design and construction of the product shall be submitted in the format as shown in Appendix A.

APPENDIX A

TECHNICAL DATA INFORMATION

No	TECHNICAL REQUIREMENTS		TENDERER OFFER	TNB REQUIREMENT
1	Type No. / Trademark / Manufacturer			
2	Nominal Voltage	kV		33 kV
3	Rated Voltage (U_r)	kV		36 kV
4	Rated Frequency	Hz		50 Hz
5	Prospective Short Circuit Current	I_{sc}		≥ 25kA
6	Arrester Classification			SL
7	Standard Nominal Discharge Current (8/20 µs)	I_n		10 kA_{peak}
8	High Current Impulse Withstand (4/10µs)	I_{hc}		100 kA_{peak}
9	Thermal Charge Transfer Rating @ U_r	W_{th}		≥ 4.0 kJ/kV (U_r)
10	Repetitive Charge Transfer Rating	Q_{rs}		≥ 1.0 C
11	Maximum Continuous Operating Voltage (MCOV)	U_c		28.8 kV
12	Maximum Residual Voltage @ I_n	kV		≤ 127.5 kV
13	Lightning Impulse Withstand Voltage (Dry)	kV_{peak}		170 kV
14	Power Frequency Withstand Voltage - Wet (kV)	kV		≥ 70 kV
15	Minimum Creepage Distance	mm		≥ 720 mm
16	Minimum Cantilever Strength	Nm		≥ 250
17	Material of Insulator Housing			Silicone Rubber
18	Construction of Insulator Housing			Directly Molded / Mold-in-Place onto MO Blocks

APPENDIX A (continued)

TECHNICAL DATA INFORMATION

No	TECHNICAL REQUIREMENTS	TENDERER OFFER	TNB REQUIREMENT
19	Arrestor Disconnecting Device Provided	Yes/No	Yes
20	Line Terminal Clamps with M12 Stud for Aluminum/Copper Conductor Provided	Yes/No	Yes
21	Earth Terminal Clamps with M12 Stud for 50mm^2 Copper Conductor Provided	Yes/No	Yes
22	Mounting Clamps Provided	Yes/No	Yes
23	Insulating Bracket Provided	Yes/No	Yes
24	Insulating Cover for Arrester Provided	Yes/No	Yes
25	Drawings of Design and Construction	Enclosed / Not Enclosed	Enclosed
26	Type Test Reports as per IEC 60099-4 (2014) Submitted:		
a.	Insulation withstand tests	Yes/No	Yes
b.	Residual voltage tests	Yes/No	Yes
c.	Test to verify long term stability under continuous operating voltage	Yes/No	Yes
d.	Test to verify the repetitive charge transfer rating, Q_{rs}	Yes/No	Yes
e.	Heat dissipation behavior of test sample	Yes/No	Yes
f.	Operating duty tests	Yes/No	Yes
g.	Power frequency voltage-versus-time test	Yes/No	Yes
h.	Tests of arrester disconnector	Yes/No	Yes
i.	Short-circuit tests	Yes/No	Yes
j.	Test of the bending moment	Yes/No	Yes
k.	Weather ageing test	Yes/No	Yes