

KARNATAKA POWER TRANSMISSION CORPORATION LIMITED

TECHNICAL SPECIFICATIONS

SECTION – – SURGE ARRESTORS FOR 220KV SUB-STATIONS

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SECTION –SURGE ARRESTERS

Section -Surge Arrestors

1.0 GENERAL

- 1.1 Qualifying Requirements please refer Bid Documents
- 1.2 The surge arresters shall conform to IEC: 60099 except to the extent modified in the specification and shall also be in accordance with requirements under 6.0 of Technical Particulars.
- 1.3 Arresters shall be of hermetically sealed units, self-supporting construction, suitable for mounting on tubular / lattice type support structures to be supplied by the Contractor.

2.0 DUTY REQUIREMENTS:

- a. The surge arresters shall be of heavy - duty station class and gapless type (i.e., metal oxide type) without any series or shunt gaps.
- b. The surge arresters shall be capable of discharging over-voltages occurring during switching of unloaded transformers and long lines.
- c. 198 KV class arrester shall be capable of discharging energy equivalent to class 3 of IEC for 245 KV system on two successive operations.
- d. 96 KV, 60 KV, 30KV and 9 KV class arresters shall be capable of discharging energy equivalent to class 3/2 (as applicable) of IEC for 123 KV, 72.5 KV, 36 KV and 12 KV system for two successive operations.
- e. The surge arresters shall be suitable for withstanding forces as defined in Technical Particulars under 6.0
- f. The reference current of the arresters shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.
- g. The surge arresters are being provided to protect the following equipment whose insulation levels are indicated in the table give below:

Equipment to be protected	Lightning impulse(KVP) for 245 KV system	Lightning impulse(KVP) for 123 KV system	Lightning impulse(KVP) for 72.5 KV system	Lightning impulse(KVP) for 36 KV system
1	2	3	4	5
Power transformer	±950	±550	±325	±170
Instrument Transformer	±1050	±550	±325	±170
CB/Isolator phase to ground	±1050	±550	±325	±170
Across open contacts	±1200	----	-----	----

- h. The duty cycle of CB proposed to be installed in 245 KV / 123 KV / 72.5 KV System is 0-0.3 sec. - CO- 3 min - CO. The surge arrester shall be suitable for such circuit breaker duties in the system.

3.0 CONSTRUCTIONAL FEATURES:

The feature and constructional details of surge arresters shall be in accordance with requirement stipulated hereunder:

- The non - linear blocks shall be of sintered metal oxide material. These shall be provided in such a way as to obtain robust construction, with excellent mechanical and electrical properties even after repeated operations.
- The surge arresters shall be fitted with pressure relief devices suitable for preventing shattering of arrester housing and providing path for flow of rated fault currents in the event of arrester failure. Details shall be furnished in the bids along with quality checks.
- The arresters shall not fail due to arrester, housing contamination.
- Seals shall be provided in such a way that these are always effectively maintained even when discharging rated lightning current.
- Outer insulator shall be porcelain / Polymer conforming to requirements stipulated in Technical Parameters under 6.0. Terminal connectors shall be in accordance with the requirement.

- f) Outer insulator housing shall be so coordinated that external flashover will not occur due to application of any, impulse or switching surge voltage up to the maximum design value for arrester.
- g) The end fittings shall be made of nonmagnetic and corrosion proof material and preferably, be nonmagnetic.
- h) The nameplate shall conform to the requirements of IEC incorporating the year of manufacture.
- i) The heat treatment cycle details along with necessary, quality checks used for individual blocks along with insulation layer formed across each block are to be furnished. Metalizing coating thickness for reduced resistance between adjacent discs is to be furnished with additional information schedule of bid proposal sheets along with procedure for checking the same. Details of thermal stability test for uniform distribution of current on individual disc is to be furnished.

The manufacturer will submit data for rejection rate of ZnO blocks during manufacturing/ operation for the past three years.

Porcelain Housing:

- i. All Porcelain housing shall be free from lamination cavities or other flaws affecting the maximum level of mechanical and electrical strengths.
- ii. The Porcelain shall be well vitrified and non-porous.
- iii. The Creepage distance of the arrester housing shall be as per Technical Parameters under 6.0
- iv. The Porcelain petticoat shall be preferably of self-cleaning type (Aerofoil design). The details of the porcelain housing such as height, Angle of inclination, shape of petticoats, gap between the petticoats, diameter (ID and OD) etc., shall be indicated by the Bidder in his offer in the form, during detailed drawings.
- v. The Arrester housing shall conform to the requirements of latest IEC 60099-4 specification. Amended up to date.

Polymer Housing:

- i. Polymer housing material shall be silicon rubber. Polymer Rubber housing shall be free from lamination cavities or other flaws affecting the maximum level of mechanical and electrical strengths. Properties of the polymeric materials shall be specified in the offer and test reports for the same from a NABL accredited laboratory shall be submitted for approval

of the purchaser. The polymer material which is used for arrester housing must have resistance to tracking & erosion, and stabilized against UV radiation.

- ii. The rain sheds/petticoats shall be of polymeric material and shall conform to the properties and type test reports shall be submitted and shall not be pre-molded push on type or slip on type. The adhesion between the polymeric housing and the metal oxide resistors or any other metallic or non-metallic parts inside the housing must be strong enough, homogeneous, robust and resistant to thermal cycles and environmental stresses. Tests shall be carried out on each batch during manufacturing and records maintained and provided as & when required during inspection.
- iii. The Creepage distance of the arrester housing shall be as per Technical Parameters under 6.0.
- iv. The Polymer weather shed design shall be preferably of self-cleaning type (Aerofoil design). The details of the Polymer housing shed profile such as distance, angle of inclination, gap between the shed, diameter (ID and OD) etc. shall be as per relevant standard and shall be indicated by the Bidder in his offer in the form, during detailed drawings.
- v. The Arrester housing shall conform to the requirements of latest IEC 60099-4 specification. Amended up to date.

4.0 FITTINGS AND ACCESSORIES:

- a) 198 KV / 96 KV / 60 KV / 30 KV / 9 kV arresters shall be complete with insulating base having provision for bolting to flat surface of structure.
- b) Self contained discharge counters, suitably enclosed for outdoor use and requiring no auxiliary or battery supply for operation shall be provided for each single pole unit along with necessary connection. Suitable leakage current meters should also be supplied within the same enclosure. The reading of milli-ammeter and counters shall be visible through an inspection glass panel. The terminals shall be robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends. The design of the surge monitor shall be such that it is possible to tilt the surge monitor downwards by an angle of up to 45° from Horizontal plane.
- c) Surge monitor consisting of Discharge counters and milli-ammeters should be suitable to be mounted on support structure of the arrester and should be tested for IP: 55 degree of protection. The standard supporting structure for surge arrester should be provided with a standard mounting pad, for fixing the surge monitor. The surge monitor should be suitable for mounting on this standard mounting pad. Also all nuts, bolts, washers

etc., required for fixing the surge monitor shall have to be supplied by the Contractor.

- d) Grading / Corona rings shall be provided on each complete arrester unit as required. Suitable terminal connectors shall be supplied by the contractor.

5.0 TESTS:

5.1 Type tests : Type tested surge arresters shall be offered. The type test reports shall not be older than Fifteen (15) years for 66kV and above voltage level, Five (5) for below 66kV Voltage level on the last date of submission of bid.

a) For Surge Arrestors manufactured in India:

- i. The type tests on indigenous equipment for which testing facility is available in India, should have been conducted in any independent laboratories approved by the Government or the laboratories accredited by the National accreditation body of the country like Central Power Research Institute (CPRI), Electrical Research and Development Association (ERDA), etc.
- ii. The type tests on indigenous equipment, for which testing facility is not available in India, should have been conducted in a laboratory of foreign country accredited by National accreditation body of that country.
- iii. The type tests conducted in-house by a manufacturer shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests has been conducted in the presence of a representative of NABL accredited laboratory or any of the purchasing utilities or CEA in that order. Such type test reports shall record the details of such witness including the signature/authentication in the type test report.

b) For Surge Arrestors manufactured Abroad:

- i. Type tests on imported equipment should have been conducted in an Indian Laboratory or foreign laboratory accredited by National accreditation body of the country where the Type test has been conducted.
- ii. The type tests conducted in-house by a manufacturer shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests has been conducted in the presence of a representative of accredited laboratory or any of the purchasing utilities or CEA in that order. Such type test reports shall

record the details of such witness including the signature/ authentication in the type test report.

In case of in-house type tested imported equipment of foreign OEM, the term “Purchasing Utility” covers the foreign Utility who has purchased that equipment.

The surge arresters should have been type tested as per IEC / IS & the following additional type tests on 198 KV surge arresters. They shall also be subjected to routine and acceptance tests in accordance with IEC document. In the switching surge operating duty test, the samples shall be pre heated to 70° C (instead of 60° C as given in IEC) prior to application of long duration surges. For contamination test procedures outlined in ANSI - 062-11-1987 may be followed until IEC brings out alternate test procedure for the same. The following additional type tests in case of 198 KV class surge arrester arc to be conducted along with other type tests as per IEC - 60099.

- i) Radio interference voltage test (as per Annexure - A).
 - ii) Seismic withstand test (as per Annexure B).
 - iii) Contamination test.
 - iv) Temporary over voltage withstand test (Procedure to be mutually agreed).
- The contractor shall submit type test procedures along with the bid each metal oxide block of surge arresters shall be tested for the guaranteed specific energy capability- in addition to the routine acceptance test as per IEC - 60099.

NOTE:

All type tests on Polymer housing material shall be in accordance with IEC 61462, test reports for the same shall be furnished.

5.2 a) Acceptance Tests :

- 1.Measurement of power frequency reference voltage of the arrester units.
- 2. Lightning Impulse residual voltage on arrester units (IEC clause 6.3.2).
- 3. Internal Ionisation or partial Discharge test.

b) Special Acceptance Test;

- 1. Thermal stability test on three sections (IEC 7.2.2)
- 2. Aging & Energy capability test on blocks (Procedure to be mutually agreed)

3. Watt loss test

c) Routine tests :

1. Measurement of Reference voltage
2. Residual voltage test of arrester unit.
3. Internal Ionization test or partial discharge test.
4. Sealing test.
5. Verticality checks on completely assembled surge arresters as a sample test on each lot.

d) Test on surge monitors:

The surge monitors shall also be connected in series with the test specimens during residual voltage and current impulses withstand tests to verify efficiency of the same. Additional routine / functional tests with one 100 A and 10 KA current impulse, (8 / 20 micro sec.) shall also be performed on the surge monitor.

e) Test on insulators :

All routine tests shall be conducted on the hollow column insulators as per IEC 62155. The following additional tests shall be carried out on 245KV insulators.

1. Ultrasonic test as a routine test
2. Pressure test as a routine tests.
3. Bending load test in 4 directions at 50 % specified bending load as a routine test.
4. Bending load test in 4 directions at 100 % specified Bending load as a sample test on each lot.
5. Burst pressure test as a sample test on each lot.

SPARE PARTS:

Bidder shall include spare parts in his proposal, if required.

6.0 PARAMETERS :

A. SURGE ARRESTER:

- | | | | | | | |
|----|---------------------------|-----|----|----|----|---|
| a) | Rated arrester voltage KV | 198 | 96 | 60 | 30 | 9 |
|----|---------------------------|-----|----|----|----|---|

b) Nominal discharge Current of 8 / 20 micro sec wave	10KA	10KA	10KA	10 KA	5 KA
c) Minimum discharge capacity	5kJ / KV (referred to rated arrester Voltage Corresponding to minimum Discharge Characteristics)				
d) Continuous operating voltage at 50 deg C KV	168	81	50	20	7.5
e) Max. switching surge residual voltage (1 KA) kVp	500	272	175	85	---
f) Max. residual voltage kVp at					
i) 5 KA	560 kVp				
ii) 10 KA nominal discharge current (kVp)	600		195		
g) Max. steep current impulse residual volt-age at 10 kA	650 kVp				
h) Long duration discharge class	SM	SM	SM	SM	
i) High current short duration test value (4/ 10 micro second wave)	100 kAp	100 kAp	100 kAp	100 kAp	
j) Current for pressure relief test KA RMS	40	40	40	25	
k) Low current long duration test value (2000 micro see)	----- As per IEC -----				
l) Pressure relief class	-----A-----				
m) Insulation Level					
i) Full wave impulse withstand voltage (1.2/50 micro sec.)					
1. Arrester Housing (kV peak)	±1050	±550	±325	±170	±75
ii) Switching impulse withstand voltage (250/2500 micro sec) dry and wet					
1. Arrester housing (kV peak)	-----NA-----				
iii) One minute power frequency dry withstand voltage					
1. Arrester housing (kV rms)	460	230	140	70	28

n) Minimum creepage distance (mm)	6125	3075	1815	900	305
o) Cantilever strength (for 1 minute withstand test) (kg)	150	150	150	150	150
p) Maximum deflection at above cantilever load (mm)	200	200	200	200	200

Note :- In isolated OR unearthed Neutral system, the voltage rating of the S.A. should be 110% of the nominal voltage in the case of capacitor bank.

7.0 TESTING AND COMMISSIONING:

An indicative list of tests is given below. Contractor shall perform any additional test based on specialities of the items as per the Field Quality Program / Instruction of the equipment supplier or owner without any extra cost to the owner. The contractor shall arrange all instruments required for conducting these tests along, with calibration certificates and shall furnish the list of instruments to the owner for approval.

- a) Leakage current measurement
- b) Resistance of ground connection.

ANNEXURE - A CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 General:

Unless otherwise stipulated. All equipment together with its associated connectors, where applicable, shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV).

2.0 Test levels:

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3.0 Test methods for RIV:

3.1 RIV tests shall be made according to measuring circuit as per International Special- Committee on Radio Interference (CISPR) publication 16-1 (1993) Part - 1. The measuring circuit shall preferably be tuned to frequency with 10% 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts,

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of RIV, temporary additional external corona. shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage. is listed in the detailed specification together with maximizing permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation of equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noises meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltages at the high voltage terminal to voltage read by noise meter.

4.0 Test methods for visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise value. The test voltage shall be raised to 130% of RIV test voltage and

maintained there for five minutes. The voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, 115% and 130%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energized connectors. The photographs shall be framed such that, test object, essentially, fills the frame with no cut-off.

4.1 The test shall be recorded on each photograph. Additional photographs shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.

4.2 In addition to photographs of the test object at least four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Owner's inspector, after determining the best camera locations by trial energization of test object at a voltage which results in corona.

4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

4.4 However, both tests shall be carried out with the same test set up and as little time duration between tests as possible. No modification or treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction Voltage testing may be permitted at the discretion of Owner's inspector if, in his opinion, it will not prejudice other test.

5.0 Test

Records:

In addition to the information previously mentioned and these requirements specified as per CISPR or NEMA 1.07 -1961 the following data shall be included

in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurement's of RIV levels expressed in micro volts at each level.
- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE-

B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (except Power Transformer) shall be carried out along with supporting structure.

The Bidder shall arrange to transport the structure from his Supplier's premises/KPTCL sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Owner. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Owner.