33 KV STATIC SHUNT CAPACITOR WITH ALLIED EQUIPMENT

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Engineering Department

WEST BENGAL STATE ELECTRICITY TRANSMISSION COMPANY LIMITED

পশ্চিমবঙ্গ রাজ্য বিদ্যুৎ সংবহন কোম্পানি লিমিটেড

(পশ্চিমবঙ্গ সরকারের একটি উদ্যোগ)

Regd. Office: VidyutBhawan, Block – DJ, Sector-II, Bidhannagar, Kolkata – 700091.

CIN: U40101WB2007SGC113474; Website: www.wbsetcl.in

33 KV STATIC SHUNT CAPACITOR WITH ALLIED EQUIPMENT

SCOPE

i) This specification covers design & engineering, manufacture, testing at manufacturer's works of 33 KV, 3-ph capacitor banks with all accessories, allied equipment including structures, support insulators, clamp connectors at site for outdoor installation along with accessory equipment complete in all respect.
ii) Design of structures for Capacitor Bank and series reactors should be such that it could accommodate capacitor units for at least 20MVAR irrespective of the ratings of the bank and suitable for mounting on plinth in outdoor switchyard.
iii) The supporting structures for the capacitor banks and series reactors with pedestal insulators including other accessories are within the scope of this specification.

STANDARD

The capacitor banks and accessories covered by this specification all conform to latest edition of IS or IEC publication as amended up to-date, unless specifically stated otherwise in this specification, as follows:

a)	Capacitor	IEC/871-1/87/, IS:13925(Part-1) 1998
b)	Series Reactor	IS:5553
c)	Internal fuse	IEC593

DEVIATION

Normally the offer should be as per Technical Specification without any deviation. But any deviation felt necessary to improve performance, efficiency and utility or equipment must be mentioned in the 'Deviation Schedule' with reasons of such deviation. Such deviation suggested may or may not be accepted. Deviations not mentioned in Deviation Schedule will-not be considered.

SYSTEM DESCRIPTION AND CONSTRUCTIONAL DETAILS OFCAPACITOR BANK

i) The Capacitor Bank are used for a 3-phase, 50 Hz, 33 KV system. 33 KV, 20MVAR &10 MVAR Capacitor Bank shall consist of individual small units connected in series/phase and parallel/phase combination connected in double star formation and unbalance protection by neutral current transformer.
ii) Neutral protective current transformer (NCT) shall be of suitable ratio to operate Protective relays. The voltage rating of the NCT shall be decided by taking into consideration the voltage impressed on the NCT when all the parallel units in one series bank fail simultaneously. Design calculation for the same is to be submitted.
iii) The protective scheme shall be such that, the failure of one or more unit causes an over-voltage of less than 10% tolerable on the other remaining healthy units, then the unbalance

current shall cause in the first step to sound an alarm. But if more than the above number of units fails causing a voltage rise of more than 10% then the unbalance current shall cause to trip and isolate the capacitor bank instantaneously.

iv) Vacuum circuit breaker suitable for Capacitor bank duty and line CTs are to be provided for protection purpose. CTs are provided for metering and O/C, E/F protection.

v) NCT is provided to detect the unbalance on account of failure of element in any of the capacitor unit and will trip the breaker through unbalance protection relay provided in the control & relay panel.

vi) O/V and U/V relays are provided in the control & relay panel to be energized from Sub Station PT secondary and shall trip the breaker in case of O/V and U/V of the system.

vii) The per phase and individual star group rating shall be built by series parallel combination of individual unit so as to achieve the desired bank rating. The individual capacity rating shall be as per IS: 13925 Part-I.

viii) All parallel units in one series group shall preferably be arranged in different tiers. One series group shall be duly insulated from another by post insulators adequate to withstand the voltage that may be impressed and shall be sufficient to withstand even in case of total failure.

ix) Individual units shall be designed to meet with the requirements of the permissible overloads as specified as per IS: 13925. Each unit shall also be provided with internal discharging devices complying with the requirements of IS.

x) Each capacitor unit in the Bank shall be totally sealed, self-contained outdoor type having 2 bushing suitably rated for series/parallel connections with other units to form the capacitor bank of rated capacity at 50Hz. The bushing shall be of porcelain and shall be joined to case preferably by welding.

xi) Each capacitors units shall be mounted so that it can be easily removed from the racks and replaced without removing other units, de-assembling any portion of the rack.

CAPACITOR LOSSES

The capacitor shall be of low loss type. The losses in watts for each capacitor unit including losses in fuses and discharge resistors forming integral part of the capacitors along with losses for series reactor shall be guaranteed. If the test figures of capacitor losses exceed 0.2 W/KVAR, the capacitors will be liable for rejection. Total losses shall be complied as below:

6 X (W X n + losses in series reactor/phase/star connection)

- Where n is number of capacitor units per phase of star connection and W is the total loss in a capacitor unit.

Losses in series reactor shall be furnished separately.

CAPITALISATION OF LOSSES AND LIQUIDATED DAMAGES

The dielectric losses of capacitors, and I^2R loss of series reactor etc. will be capitalized during evaluation of the bid at the rate of Rs.2,00,000.00 (Rupees two lakh) only per KW. The losses shall be **guaranteed maximum figures**. The test figures will be compared with corresponding guaranteed figures and the liquidated damages will be calculated at the rate of Rs.2,00,000.00 (Rupees two lakh) only per KW for the excess of differences between the test figures over the corresponding guaranteed figures. No tolerance shall be permitted over the test figures or losses. For fraction of KW, penalty shall be applied pro-rata basis.

TECHNICAL REQUIREMENTS OF CAPACITOR BANK

i)	Nominal system voltage (KV)	:	33
ii)	Highest system voltage (KV)	:	36
iii)	Minimum KVAR capacity required at nominal system voltage	:	20,000 / 10,000
iv)	a) Rated voltage of capacitor banks (KV) b) Rated output of capacitor bank at rated voltage (KVAR)	:	38 26,520 / 13,260
v)	Permissible Overloads: a) Current b) Voltage c) KVAR	:	 180% 110% 130%
vi)	Capacitor Tolerance	:	- 0, + 10%
vii)	Discharge Time	:	600 sec to <= 50V (max.)
viii)	Case	:	CRCA with minimum thickness 1.25mm
ix)	Paint	:	Epoxy / Urethane
x)	Bushing	:	Two bushing shall be welded / press fit to the case. Solder system is not acceptable
xi)	Dielectric System	:	Polypropylene
xii)	Reliability	:	Avg. annual failure rate shall be low and **annual failure rate is to be furnished**.
xiii)	Connection of capacitor bank	:	Double star with ungrounded neutral.
xiv)	Rating of capacitor units (Improved design with different ratings may be considered)	:	As per Table-I
xv)	No. of units per bank	:	As per Table-I
xvi)	Minimum capacitor KVAR available at nominal system voltage (with no series reactor)	:	As per requirement of design and to be specified with supporting calculations for verification.
xvii)	Fuse	:	Internal element fuse. Means for indication of fuse out after 5% VAR reduction / dropof rating shall be provided.
xviii)	Power loss (tan delta) including loss in fuse	:	Not to exceed 0.2W / KVAR

Table - 1

Rating in 38KV (KVAR)	Rating of each unit of the Bank	Voltage for each unit (KV)	Normal current for each unit (Amps)	No of series group / phase / star	No of parallel units / SG / Star / Phase	Total no of units / Phase / Star	Total no of units per Bank
13260	552.5	10.97	52	2	2	4	24
26520	552.5	10.97	52	2	4	8	48

33KV CIRCUIT BREAKER

33KV vacuum Circuit Breaker of standard design and suitable for breaking capacitor bank current shall be used for isolation of capacitor bank in case of fault or failure of capacitor unit. The breaker will be tripped through protective relays provided in the control & relay panel for O/V, U/V, O/C, E/F and unbalance current between neutral of double star connected capacitor bank.

Circuit Breaker should be capable of capacitor bank duty.

SERIES REACTORS:

a) The series reactor of small size is required for limiting the inrush current. The series reactor shall be outdoor type, 50Hz, air cooled, air core type of Cu material.
b) Series reactors shall be capable of withstanding the specified short circuit currents.
c) The percentage series reactance shall preferably be 0.2%.
d) The series reactors shall conform to type tests and shall be subjected to routine tests as per IS.

TECHNICAL REQUIREMENTS OF SERIES REACTOR

a.	Highest System voltage (KV)	36
b.	Type	Air core
c.	Rating of series reactors	0.2% of capacitor bank rating to be connected on neutral end
d.	Basic Insulation levels -	
	Impulse withstand voltage / power frequency withstand voltage	170 KV peak / 70 KV rms
e.	Short-time withstand capacity and duration	16.5 times of 130% rated current of capacitor bank for 3 seconds.
f.	Linear characteristic	Upto 1.5 p.u.
g.	Continuous rating	130% of rated current of capacitor bank.
h.	Creepage distance (mm)	900
i.	Temperature rise	As per IS:5533 Part-II
j.	Material of windings	Copper

TECHNICAL REQUIREMENTS OF NEUTRAL CURRENT TRANSFORMER

a.	Highest system voltage	36 kV
b.	Rated voltage	33 kV
c.	Reference standard	IS-2705
d.	Ratio	2/1/1 A or as required for unbalance protection
e.	No. of Core	2
f.	Rated VA Burden Core I&II	30

g.	Accuracy class Core I&II	5P-20
h.	Accuracy limit factor Core-I&II	Not less than 20
i.	Creepage distance (mm)	900
j.	Basic Insulation levels - Impulse withstand voltage / power frequency withstand voltage	170 KV peak / 70 KV rms

Note: Calculation for rated burden of CT & NCT shall be furnished and may be finalised during detail engineering. Calculations of unbalancing should be submitted for approval / record.

CAPACITOR UNITS WITH INTERNAL FUSES:

The internal fuses shall conform to IEC: 593/IS:12762 and the Bidder shall furnish type test certificates for compliance with IEC/IS.

a) The design of the internal fuse shall be such that residues from fuse operation(s) shall not cause deterioration of the impregnating fluid.
b) The fuses shall not melt or deteriorate when subjected to inrush currents.
c) The design of the fuse shall be such that it shall isolate only the faulty element and the operation of the fuse shall not affect the other healthy element.

MOUNTING RACKS

a) The mounting racks shall be hot dip galvanized steel sections. Each end of the rack shall have provision to receive incoming line connection.
b) The racks shall be complete with rack insulators, foundation bolts or any other hardware etc. for assembly into complete bank.
c) The height of the racks of capacitor banks shall be such that for making electrical connections with other equipment, proper electrical clearances are maintained.

TENDER DRAWINGS, CATALOGUE AND TEST CERTIFICATE

Following drawings, catalogue and type test certificates shall be submitted for information purpose with each copy of tender:

i) Equipment layout elevation and plan with all technical details.
ii) Schematic diagram of capacitor bank with series reactor along with protection scheme.
iii) Descriptive literature, catalogue etc.
iv) Type test certificates of capacitor units carried out on similar capacitor from recognised reputed laboratory shall be submitted. Type test results of other equipment shall also be submitted.

TESTS

a) Type Test:

The equipment offered should be type tested. Type test report should be carried out in Govt./Govt. approved test house.

i) Thermal stability test.
ii) Impulse withstands tests between terminal containers.
iii) Endurance test as special test.

The remaining type test report as per clause 12.2 of ISS:13925 (Part-I):98 shall be submitted by the successful bidder.

b) Acceptance & Routine Test:

The equipment shall comply with all routine and acceptance tests as per IS: 13925(Part-I). Sampling to be done as per Appendix-E, IS: 13925.

Acceptance tests at manufacturer's works shall be carried out on selected number of capacitor units in presence of representative of WBSETCL and three (3) copies of test results along with routine test results of brought out items shall be submitted for approval. The contractor shall give a notice of at least 15 (fifteen) days in advance of the date when the tests will be carried out.

PROTECTIVE COATINGS

All ferrous parts including bolts, nuts and washers of the equipment shall be galvanized to withstand at least four one minute dips in copper sulphate solution of requisite strength as per latest relevant IS.

CONTRACT DRAWINGS , CATALOGUE AND MANUAL

After placement of purchase order or letter of acceptance (LOA) six (6) copies of various drawings, data and catalogue/manual as mentioned below shall be submitted for approval.

i) Outline general arrangement drg. of capacitor bank with detailed dimension of Capacitor Bank/Unit and structure with complete bill of material.
ii) Electrical Layout drawing of Capacitor Bank showing spacing of each equipment.
iii) Outline arrangement drawing of Capacitor Unit with detail dimensions.
iv) Outline general arrangement drawing of 33kV NCT, Series Reactor & CT.

Four (4) set of approved drawings and manuals on operation & maintenance both in hard & soft format shall be submitted for record and distribution at site.

GUARANTEED TECHNICAL PARTICULARS OF CAPACITORS

1.	Manufacturer's Name	
2.	Maker' s Type Designation	
3.	Standard followed	
4.	System Specification – a) Voltage b) Frequency	
5.	Ambient Temperature – a) Maximum b) Minimum	
6.	Capacitor Bank – a) Rated Output (Installed) KV & KVAR b) Rated Output (Effective) KV & KVAR c) No. of phases d) Type of connection e) No. of units per bank f) Power frequency withstand voltage, KVrms g) Impulse withstand voltage, KVpeak h) Type of Mounting i) Terminal arrangement (Incoming & Outgoing)	
7.	Capacitor Unit – a) Rated Output, KVAr b) Rated Voltage, KV c) Rated current, Amp d) No of Bushings e) Unit Protection f) Losses, Watts/KVAr g) Di-electric type h) Power frequency withstand voltage, KVrms i) Impulse withstand voltage, KVpeak j) Permissible Load i) Voltage ii) Current iii) Output k) Discharge device to discharge capacitor to 50V or less in 300secs after disconnection from supply i) Directly connected internal discharge ii) External DPT/RVT provided iii) Other discharge device	
8.	Creepage Distance, mm/KV	
9.	Annual failure rate	
10.	Clearances a) From phase to phase b) From phase to earth	
11.	Overall dimensions of capacitor bank	
12.	Total weight of capacitor unit & bank	
13.	Fuses – a) Maximum energy which fuse carrier can withstand without bursting b) Maximum continuous rating of fuse without deterioration as a percentage of capacitor unit nominal current c) Maximum recovery voltage at which fuse can operate	

GUARANTEED TECHNICAL PARTICULARS OF REACTOR

1.	Manufacturer's Name	
2.	Maker' s Type Designation	
3.	Standard followed	
4.	System Specification – a) Voltage b) Frequency	
5.	Ambient Temperature – a) Maximum b) Minimum	
6.	Type of Reactor – a) Mounting b) Core c) Shielding d) No of phases e) Connection	
7.	Reactor Rating – a) Fundamental current of the Reactor, Amps b) Minimum rated rms current including all harmonic current, Amps c) Harmonic current through the reactor d) Reactance / phase e) Maximum permissible continuous current, Amps f) Short time current i) For winding and outgoing terminal ii) For incoming terminal g) Linearity (in case of iron core reactors) h) Q-value of Reactor i) Losses in Watt/KVAr	
8.	Class of Insulation	
9.	Tolerance in Inductance	
10.	Clearances a) From phase to phase b) From phase to earth c) Magnetic clearances	
11.	Insulation level- a) Power frequency withstand voltage, KVrms b) Impulse withstand voltage, KVpeak	
12.	Winding Material	
13.	Creepage Distance, mm/KV	