BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-362-510-030	Rev. No.	00		Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION			NAME	RK	BA/VK	RS
TITLE	400 KV CURRENT TRANSFORMER			SIGN	Rajat	Brahm	Rajesh
				DATE	18.07.13	18-7-13	
				GROUP	TBEM	W.O. No	83002 AKPK
CUSTOMER	Power Grid Corporation of India Ltd.						
PROJECTS	400KV Karaikudi, Pugalur, kalavinthapattu & Abhishekpatty substations associated with Consultancy services to TANTRANSCO						

CONTENTS

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS			
				Distribution	*TBMM*	*TBQM*	*TBCM*	*TBTS*
				Copies	-	-	-	-

SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES.

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of Current transformers complete with accessories as listed in clause 1.2 & 1.3 below.

This section covers the specific technical requirements of 400kV Current Transformers. **In case of any discrepancies between the requirements mentioned in this section and those specified in the following sections of this specification, the specifications given herein shall prevail and shall be treated as binding requirements.**

1.1 The equipment is required for the following project.

Name of customer : **Power Grid Corporation of India Limited**

Name of the project : **Extension of 400kV Karaikudi, Pugalur, Kalivanthapattu & Abhishekpatty Substation**

Refer Section - 3 for Project Details and General Specifications.

Note: The terms used in this specification namely ,"Employer/Purchaser" refers to PowerGrid , "Contractor " refers to BHEL & "Sub-contractor" refers to successful bidder.

1.2 SPECIFIC TECHNICAL PARTICULARS

a. System Parameters:

S.No	Description of parameters	400kV System
1.	Maximum system voltage Um (kV)	420
2.	Impulse withstand voltage (dry & wet) (kVp)	1550
3.	Power frequency withstand voltage (dry and wet) (kV rms)	630
4.	Total creepage distance (min) (mm)	10500 *
5.	Rated Frequency	50
6.	No. of Poles	1
7.	Design ambient Temperature (°C)	50
8.	Rated Insulation Levels:	1550KVp

* Refer Note .

	a. Full wave impulse withstand Volt (1.2/5μs.). - between line terminals and ground. b. One minute power frequency dry and wet withstand voltage - Between line terminals and ground.	630 kV rms.
9.	Seismic acceleration	0.3g
10.	Partial Discharge level [pC max]	10
11.	Phase to space spacing (mm)	4000

Note: 1) The minimum total creepage distance for Kalivanthapattu S/S shall be 13020mm instead of 10500mm.
2) The rate of zinc coating for galvanized lattice and pipe structure (Excluding foundation bolt and fasteners) shall not be less than 900 gm/sq. m instead of 610 gm/sq. m specifically for Kalivanthapattu substation.
3) Kalivanthapattu substation falls under high wind zone and basic wind speed shall be considered as 50m/sec.

b. Technical Parameters of 400 KV CT:

Please refer Section II.

c. Core Parameters :

Please refer Table IIA Page 24 of 27 as per section II attached

d. The offered current transformer shall be as per POWERGRID approved standard drawings.

1.3 QUANTITIES

S.No	Description	Main Equipment	Spares	Total Quantity
1.	**For Extension of 400/230kV Karaikudi substation:** 400kV, 40kA for 1sec, 3000Amps, 5 core, single phase Current Transformer with extended current 120% along with mounting hardware.	24 Nos.	1 No.	25 Nos.
2.	**For Extension of 400kV Pugalur substation:** 400kV, 40kA for 1sec, 3000Amps, 5 core, single phase Current Transformer	36 Nos.	1 No.	37 Nos.

	with extended current 120% along with mounting hardware.			
3.	**For Extension of 400kV Kalivanthapattu substation:** 400kV, 40kA for 1sec, 3000Amps, 5 core, single phase Current Transformer with extended current 120% designed ***for minimum creepage distance of 31mm/kV along with mounting hardware***	24 Nos.	1 No.	25 Nos.
4.	**For Extension of 400kV Abhishekpatty substation:** 400kV, 40kA for 1sec, 3000Amps, 5 core, single phase Current Transformer with extended current 120% along with mounting hardware.	6 Nos.	1 No.	7 Nos.

1.4 MOUNTING STRUCTURE

The steel structures shall not be in scope of CT supplier. These shall be supplied by TBG/BHEL. However equipment fixing hardware shall be included in scope of supply.

1.5 TERMINAL CONNECTORS

The HV terminal connectors shall not be in scope of CT supplier. These shall be supplied by TBG/BHEL.

1.6 MOUNTING HARDWARE

Each CT shall be offered with set of mounting hardware viz., Nuts, Bolts, washers etc. Price of the same is deemed to be included in the offered CT price.

1.7 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

POWERGRID approved type tests reports of tests (relevant to the offered CT) conducted not earlier than ten (10) years from date of LOA i.e. 28-06-2013 , shall be submitted for approval extension.
However, the following type tests should have been conducted within 5 (five) years prior to the date of LOA i.e. 28-06-2013.
i) Lightning Impulse Test
ii) Switching Impulse Test
iii) Multiple Chopped Impulse Test (For CT)
iv) Chopped Impulse Test (For CVT)

In case the test reports are of these tests as mentioned above are conducted earlier than 5 (five) years prior to the date of bid opening, the sub-contractor shall repeat these test(s) at no extra cost to the purchaser.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

1.8 DEVIATIONS :

The bidder shall list all the deviation from the specification separately. Offers without specific deviation will be deemed to be totally in compliance with the specification and NO DEVIATION on any account will be entertained at a later date.

1.9 MANUFACTURING QUALITY PLAN:

Bidder has to follow PowerGrid approved Manufacturing Quality Plan at contract stage.

1.10 TECHNICAL REQUIREMENT

(i) The manufacturer whose current transformers are offered, should have manufactured & type tested as per IS/IEC or equivalent standard and supplied the same for the specified system voltage for CT & CVT and 25kA fault level or above (fault level applicable for current transformer only). These equipment should be in operation for at least 2 (two) years as on the date of bid opening. In addition to the above the offered Current transformer should have been manufactured and type tested to specified fault level as on the date of bid opening.

OR

(ii) Current Transformers can also be offered from current Transformer manufacturer(s) who have established production line in India based on technological support of a parent company or collaborator for the Current Transformer provided that

(a) such manufacturer(s) have manufactured and type tested the Current Transformer (as per IEC/IS or equivalent standard) to the specified fault level (fault level applicable for current transformer only).

(b) the parent company (Principal) or collaborator meets qualifying requirements stipulated under 1.10 (i) given above.

(c) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

(d) Furnishes a confirmation letter from the parent company or collaborator along with the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

SECTION - II

CHAPTER – INST
INSTRUMENT TRANSFORMERS
CONTENTS

CHAPTER - (INST)

INSTRUMENT TRANSFORMERS

1.0 GENERAL:

1.1 The instrument transformers and accessories shall conform to the latest version of the standards specified below except to the extent explicitly modified in the specification and shall be in accordance with the requirements in Section-~~GTR~~.III

Current Transformers IEC: 60044-1 (or IS:2705)

Capacitive Voltage Transformers IEC:60044-5 / IEC-60358

Inductive Voltage Transformers IEC:60044-2

1.2 The instrument transformers shall be complete with its terminal box and a common marshalling box for a set of 3 instrument transformers.

1.3 The external surface of instrument transformer, if made of steel, shall be hot dip galvanized or painted as per **Section-~~GTR~~.** III

1.4 The impregnation details alongwith tests/checks to ensure successful completion of impregnation cycle shall be furnished for approval.

1.5 The instrument transformers shall be designed for use in geographic and meteorological conditions as given in Section-~~GTR~~.III

2.0 CONSTRUCTION FEATURES:

The features and constructional details of instrument transformers shall be in accordance with requirements stipulated hereunder:

2.1 a) **Instrument transformers shall be of 800/420/245/145 kV class, oil filled/ SF6 gas filled, suitable for outdoor service and upright mounting on steel structures. 420/245/145 kV Instrument transformers and 800 kV CVT shall be with shedded porcelain/ polymer bushings/Insulators However, 800kV CTs shall be acceptable only with polymer Insulator.**

b) Bushings/Insulators shall conform to requirements stipulated in Section-~~GTR~~.III The bushing/insulator for CT shall be one piece without any metallic flange joint.

c) **Oil filling and drain plugs, oil sight glass shall be provided for CT and for electromagnetic unit of CVT etc.** The Instrument transformer shall have cantilever strength of not less than 500 kg, 500 kg, 350 kg and 350 kg **respectively for** 800/420/245/145 kV Instrument transformers. For CVT

with polymer housing, the cantilever strength shall not be less than 150kg. Oil filling and drain plugs are not required with SF6 gas filled CT.

d) Instruments transformers shall be hermetically sealed units. Bidder/ Manufacturer shall furnish details of the arrangements made for the sealing of instrument transformers *during detailed engineering*.

Bidder/Manufacturer shall also furnish the details of site tests to check the effectiveness of hermetic sealing for approval.

e) Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block.

f) In case of SF_6 filled CTs/Inductive VTs, it shall be provided with a suitable SF_6 gas density monitoring device, with NO/NC contacts to facilitate the remote annunciation and tripping in case of SF_6 leakage. Provisions shall be made for online gas filling. Suitable rupture disc shall be provided to prevent explosion.

2.2 **Terminal box/Marshalling Box:**

Terminal box shall conform to the requirements of Section-~~GTR~~. III

2.3 **Insulating Oil:**

a) Insulating oil to be used for instrument transformers shall be of EHV grade and shall conform to IS-335 / IEC - 60296 (required for first filling). Non–PCB based synthetic insulating oil conforming to IEC 60867 can also be used in the capacitor units of CVT with specific approval from the owner, the proposal for which shall be submitted during detailed engineering stage.

b) The SF6 gas shall comply with IEC-60376, 60376A and 60376B and shall be suitable in all respects for use in the switchgear under operating conditions.

2.4 **Name Plate:**

Name plate shall conform to the requirements of IEC incorporating the year of manufacture. The rated current, extended current rating in case of current transformers and rated voltage, voltage factor in case of voltage transformers shall be clearly indicated on the name plate. The rated thermal current in case of CT shall also be marked on the name plate.

The intermediate voltage in case of capacitor voltage transformer shall be indicated on the name plate.

3.0 CURRENT TRANSFORMERS:

a) Current transformers shall have single primary either ring type, or hair pin type and suitably designed for bringing out the secondary terminals in a

weather proof (IP 55) terminal box at the bottom. PF Terminal for measurement of tan delta and capacitance of the unit shall be provided. These secondary terminals shall be terminated to stud type non disconnecting terminal blocks inside the terminal box. In case "Bar primary" inverted type current transformers are offered the manufacturer will meet following additional requirements:

(i) The secondaries shall be totally encased in metallic shielding providing a uniform equipotential surface for even electric field distribution.

(ii) The lowest part of the insulation assembly shall be properly secured to avoid any risk of damage due to transportation stresses.

(iii) The upper part of insulation assembly resting on primary bar shall be properly secured to avoid any damage during transportation due to relative movement between insulation assembly & top dome.

(iv) Nitrogen if used for hermetic sealing (in case of live tank design) should not come in direct contact with oil.

(v) Bidder/Manufacturer shall recommend whether any special storage facility is required for spare CT.

b) Different ratios specified shall be achieved by secondary taps only and primary reconnection shall not be accepted.

c) Core lamination shall be of cold rolled grain oriented silicon steel or other equivalent alloys. The cores used for protection shall produce undistorted secondary current under transient conditions at all ratios with specified CT parameters.

d) The expansion chamber at the top of the porcelain insulators should be suitable for expansion of oil.

e) Facilities shall be provided at terminal blocks in the marshalling box for star delta formation, short circuiting and grounding of CT secondary terminals.

f) Current transformer's guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

g) The rated Extended currents of 800 kV and 420 kV class Current transformers shall be as given below:

	800kV, 3000A	400kV, 3000A	400kV, 2000A
Tap Ratio	**Rated extended currents in % of rated current**		
500/1	200	200	200
1000/1	---	---	200
2000/1	180	180	120 (200 for 15 min)
3000/1	120 (200 for 15 min)	120	---

The secondary winding shall be rated for 2A continuously.

Further, the intermediate tapping at 3000-2000 of metering core of 3000 A rated 400 kV and 800 kV CTs shall be suitable for using as 1000/1 ratio. The Auxiliary reactor as referred at wiring diagram No.0000-000-T-E-L-028 shall be suitable for connecting to the selected taps. The requirements of 3000A CTs are given at TABLE II-A.

For

245/145 kV class CTs, the rated extended primary current shall be 120% (or 150% if applicable) on all cores of the CTs as specified in the Section – Project.

h) For 800/420/245/145 kV current transformer, characteristics shall be such as to provide satisfactory performance of burdens ranging from 25% to 100% of rated burden over a range of 5% to 120%(or specified rated extended current whichever is higher) of rated current in case of metering CTs and up to the accuracy limit factor/knee point voltage in case of relaying CTs.

i) The current transformer shall be suitable for horizontal transportation. It shall be ensured that the CT is able to withstand all the stresses imposed on it while transporting and there shall be no damage in transit. The ~~Contractor~~ Vendor shall submit the details of packing design to the Purchaser for review.

j) For 800 kV CTs the instrument security factor at **all** ratios shall be less than ten (10) for metering core. For 420/245/145 kV CTs the instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CTs/reactor are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs/reactor shall preferably be inbuilt construction of the CTs. In case these are to be mounted separately these shall be mounted in the central marshalling box suitably wired upto the terminal blocks.

k) The wiring diagram plate for the interconnections of the three single phase CTs shall be provided inside the marshalling box. A typical wiring diagram No. 0000-000-T-E-L-028 (Sh. 1 & 2) ~~is enclosed~~

~~herewith~~ to be followed by the Bidder/Manufacturer. The Bidder/Manufacturer shall strictly adhere to it and deviations, if any, in this regard shall be brought out with justification for Purchaser's review.

l) The current transformers should be suitable for mounting on lattice support structure (for 800 kV) or pipe structure (for 420 kV and below) to be provided by the Contractor in accordance with stipulations of Section-~~GTR~~. III

m) The CT shall be so designed as to achieve the minimum risks of explosion in service. Bidder/Manufacturer shall bring out in his offer, the measures taken to achieve this.

n) 800/420/245/145 kV current transformers shall be suitable for high speed auto reclosing.

4.0 VOLTAGE TRANSFORMERS: (NOT APPLICABLE)

a) 800/420/245/145 kV Voltage transformers shall be capacitor voltage divider type with electromagnetic units and shall be suitable for carrier coupling.

b) Voltage transformers secondaries shall be protected by HRC cartridge type fuses for all the windings. In addition fuses shall be provided for the protection and metering windings for fuse monitoring scheme. The secondary terminals of the CVTs shall be terminated to the stud type non - disconnecting terminal blocks in the individual phase secondary boxes via the fuse.

c) CVTs shall be suitable for high frequency (HF) coupling required for power line carrier communication. Carrier signal must be prevented from flowing into potential transformer (EMU) circuit by means of a RF choke/reactor suitable for effectively blocking the carrier signals over the entire carrier frequency range i.e. 40 to 500 KHz. Details of the arrangement shall be furnished along with the bid. H.F. terminal of the CVT shall be brought out through a suitable bushing and shall be easily accessible for connection to the coupling filters of the carrier communication equipment, when utilised. Further, earthing link with fastener to be provided for HF terminal.

d) The electromagnetic unit comprising compensating reactor, intermediate transformer and protective and damping devices should have separate terminal box with all the secondary terminals brought out.

e) The damping device, which should be permanently connected to one of the secondary windings, should be capable of suppressing the ferroresonance oscillations.

f) The accuracy of 0.2 on secondary III for all CVTs should be maintained through out the entire burden range upto 50 VA on all the windings without any adjustments during operation.

g) 420/245/145 kV CVTs shall be suitable for mounting on tubular GI pipe in accordance with stipulations of Section-GTR.

h) It should be ensured that access to secondary terminals is without any danger of access to high voltage circuit.

i) A protective surge arrester shall be provided *if required,* to prevent breakdown of insulation by incoming surges and to limit abnormal rise of terminal voltage of shunt capacitor/primary winding, tuning reactor/RF choke etc. due to short circuit in transformer secondaries. In case of an alternate arrangement, bidder shall bring out the details in the bid.

j) The wiring diagram for the interconnection of the three single phase CVTs shall be provided inside the marshalling box in such a manner that it does not deteriorate with time. *A typical wiring diagram no. : 0000-000-T-E-L-029 is enclosed herewith to be followed by the Bidder/Manufacturer. The Bidder/Manufacturer shall strictly adhere to it and deviations, if any, in this regard shall be brought out with justification for Purchaser's review.*

5.0 TERMINAL CONNECTORS:

The terminal connectors shall meet the requirements as given in Section-GTR.

6.0 TESTS:

6.1 In accordance with the requirements in Section-~~GTR~~ III, Current and Voltage Transformers should have been type tested and shall be subjected to routine tests in accordance with IEC:60044-1/IS:2705 and IEC: 60044-5/60044-2 respectively.

6.2 The test reports of the type tests and the following additional type tests (additional type tests are required for Instrument Transformers, rated above 72.5 kV only) shall also be submitted for the Purchaser's review.

a) **Current Transformers:**

i) **Corona** & Radio interference voltage test as per Annexure-A of Section-~~GTR~~ III **& IEC 60044-1.**

ii) Seismic withstand test as per Annexure-B of Section-~~GTR~~. III

iii) Thermal stability test, i.e. application of rated voltage and rated extended thermal current simultaneously by synthetic test circuit. (not applicable for SF6 filled CT)

iv) Thermal co-efficient test i.e. measurement of tan delta as a function of temperature (at ambient and between 80°C & 90°C) and voltage (at 0.3, 0.7, 1.0 and 1.1 Um/√3) (not applicable for SF6 filled CT)

v) The current transformer shall be subjected to **Multiple chopped impulse test (not applicable for SF6 filled CT)** by any one of the following two methods given below to assess the CT performance in service to withstand the high frequency over voltage generated due to closing & opening operation of isolators. Alternatively, method as per IEC:60044-1 may be followed:

***Method I**: 600 negative polarity lightning impulses chopped on crest will be applied to current transformer. The opposite polarity amplitude must be limited to 50% of crest value when the wave is chopped. Impulse crest values will be 1000 kVp for 420 kV CTs. One impulse per minute shall be applied and every 50 impulse high frequency currents form the windings and total current to earth will be recorded and be compared with reference currents recorded applying one or more (max 20) reduced chopped impulses of 50% of test value.*

Oil samples will be taken before and 3 days after the test. Gas analysis must not show appreciable rate of increase in various gases related with the results of the analysis performed before test.

Total sum of crest values of current through secondaries must not exceed 5% of the crest value of total current to earth.

CT must withstand dielectric tests after this test to pass the test.

***Method II**: 100 negative polarity impulses with a rise and fall time of less than 0.25 microsecond having 950 kV for 420 kV CT corrected to atmospheric condition shall be applied at one minute interval and total current through insulation of earth will be recorded. The amplitude of first opposite polarity should be limited to 50% of the chopped impulse crest value. Voltage and total current wave shapes shall be recorded after every 10 impulses, and will be compared with reference wave shapes recorded before test at 50% of test values.*

Oil sample shall be taken before and 3 days after the test and CT shall be deemed to have passed the test if the increase in gas content before and after test is not appreciable.

b) **Voltage transformers:** (NOT APPLICABLE)

i) High frequency capacitance and equivalent series resistance measurement (as per IEC-60358).

ii) Seismic withstand test (as per Annexure-B of Section-GTR).

iii) Stray capacitance and stray conductance measurement of the low voltage terminal (as per IEC-60358).

iv) Determination of temperature coefficient test (as per IEC-60358).

v) **Corona** & Radio interference **voltage** test as per IEC-60044-5, **IEC-60044-2 or** as per Annexure-A of Section-GTR. However the RIV level shall be as specified in clause Major Technical Parameters in Section-GTR.

vi) (Clause deleted.)

vii) Apart from the above, report of all special tests mentioned in IEC-60044-5 for Capacitive voltage transformer shall also be submitted for approval.

6.3 The current and voltage transformer shall be subjected to the following routine tests in addition to routine tests as per IEC/IS.

a) **CURRENT TRANSFORMERS:**

ROUTINE TESTS:

for Oil filled CTs

i) Measurement of Capacitance.

ii) Oil leakage test.

iii) Measurement of tan delta at 0.3, 0.7, 1.0 and 1.1 Um/√3.

for SF6 filled CTs

i) Dew point measurement

ii) SF6 alarm/ lockout check.

iii) SF6 leakage test . Gas leakage rate shall be maintained within 0.2% per annum.

b) **VOLTAGE TRANSFORMERS:** (NOT APPLICABLE)

Routine tests on Capacitive voltage transformer shall be done in line with IEC-60044-5.

7.0 SPARE PARTS AND MAINTENANCE EQUIPMENT:

The Bidder shall include in his proposal spare parts equipment in accordance with Section ~~Project~~ I .

8.0 TECHNICAL PARAMETERS:

A. 420 kV CURRENT TRANSFORMERS:

A8.1	Rated Primary current	2000 A/3000A (as applicable)
A8.2	Rated short time thermal current for 1 sec.	40 kA/50kA/63kA (as applicable)
A8.3	Rated dynamic current kA (peak)	100 /125/157.5 (as applicable)
A8.4	Maximum temperature rise over design ambient temperature	As per IEC:60044-1
A8.5	One minute power frequency withstand voltage sec. terminal & earth	5 kV
A8.6	Number of terminals	All terminals of control circuits are to be wired upto marshaling box plus 20% spare terminals evenly distributed on all TBs.
A8.7	Type of insulation	Class A

Current transformers shall also comply with requirements of Table - IIA.

B. 245 kV CURRENT TRANSFORMERS: (NOT APPLICABLE)

B8.1	Rated Primary current	1600 A
B8.2	Rated short time thermal current	40 kA for 1 sec/50 kA for 1 sec. (as applicable)
B8.3	Rated dynamic current kA (peak)	100 / 125 (as applicable)
B8.4	Maximum temperature rise over design ambient temperature	As per IEC:60044-1
B8.5	One minute power frequency withstand voltage sec. terminal & earth	5 kV
B8.6	Number of terminals	All terminals of control circuits are to be wired upto marshaling box

	i) Between LV (HF) terminal and earth terminal	10 kV (rms) for exposed terminals and 4 KV (rms) for terminals enclosed in a weather proof box
	ii) For secondary winding	3 kV (rms)
F8.7	Maximum temperature rise over design ambient temperature	As per IEC:60044-2 or 60044-5
F8.8	Number of terminals in control cabinet (interpole pole cabling is to be supplied by Purchaser)	All terminals are wired upto marshaling box plus 12 terminals exclusively for Purchaser's use.
F8.9	Rated Total Thermal burden (VA)	300 (100VA/winding)

Voltage Transformers shall also comply with the requirements of Table-IC of this Section.

G. TECHNICAL PARAMETERS FOR 72.5 kV VOLTAGE TRANSFORMERS (NOT APPLICABLE)

G.8.1.	System Fault level	25kA for 3 second
G.8.2.	Standard reference range of frequencies for which the accuracies are valid	96% to 102% for protection and 99% to 101% for measurement
G.8.3.	One minute power frequency withstand voltage for secondary winding	3kV (rms)
G.8.4.	Maximum temperature rise over design ambient temperature	As per IEC:60044-2 or IEC:60044-5
G.8.5.	Number of terminals in control cabinet	All terminals of control circuits are wired upto marshalling box plus 20% spare terminals evenly distributed on all TBs.

Voltage Transformers shall also comply with the requirements of Table-ID of this Section.

H 800 KV CAPACITIVE VOLTAGE TRANSFORMERS: (NOT APPLICABLE)

H.8.1	System fault level	40 kA for one (1) second
H.8.2	Standard reference range of frequencies for which the accuracies are valid	96% to 102% for protection and 99% to 101% for measurement
H.8.3	High frequency capacitance for entire carrier frequency range	Within 80% to 150% of rated capacitance

H.8.4	Equivalent series resistance over the entire carrier frequency range	Less than 40 ohms.
H.8.5	Stray capacitance and stray conductance of the LV terminal over entire carrier frequency range	As per IEC:60358
H.8.6	One minute power frequency withstand voltage :	
	i) Between LV(HF) terminal and earth terminal	10 kV (rms) for exposed terminals and 4 KV (rms) for terminals enclosed in a weather proof box
	ii) For secondary winding	3 kV (rms)
H.8.7	Maximum temperature rise over design ambient temperature	IEC:60044-2 or IEC:60044-5
H.8.8	Number of terminals in control cabinet (interpole cabling is to be supplied by Purchaser)	All terminals of control circuits are wired upto marshaling box plus 12 terminals exclusively for Purchaser's use.
H.8.9	Rated Total Thermal burden (VA)	300 VA

Voltage Transformers shall also comply with the requirements of Table-I of this Chapter.

9.0 PRE-COMMISSIONING TESTS

9.1 An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the field Q.P./Instructions of the equipment Supplier or Purchaser without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

9.2 **Current Transformers**

(a) Insulation Resistance Test for primary and secondary.

(b) Polarity test

(c) Ratio identification test - checking of all ratios on all cores by primary injection of current.

(d) Dielectric test of oil (wherever applicable).

(e) Magnetizing characteristics test.

(f) Tan delta and capacitance measurement

(g) Secondary winding resistance measurement

(h) Contact resistance measurement (wherever possible/accessible).

(i) Test for SF6 (for SF6 filled CTs) – Dew point measurement, SF6 alarm/ lockout check.

(j) DGA test of oil.

Dissolved gas analysis to be carried out at the time of commissioning. CTs must have adequate provision for taking oil samples from the bottom of the CT without exposure to atmosphere. Bidder/Manufacturer shall recommend the frequency at which oil samples should be taken and norms for various gases in oil after being in operation for different durations. Bidder/Manufacturer should also indicate the total quantity of oil which can be withdrawn from CT for gas analysis before refilling or further treatment of CT becomes necessary.

9.3 **Voltage Transformers/Capacitive Voltage Transformers** (NOT APPLICABLE)

(a) Insulation Resistance test for primary (if applicable) and secondary winding.

(b) Polarity test

(c) Ratio test

(d) Dielectric test of oil (wherever applicable).

(e) Tan delta and capacitance measurement of individual capacitor stacks.

(f) Secondary winding resistance measurement.

For pre-commissioning procedures and formats for Isolators and ground switch, Doc.No.: MR/CF/ / /R-2, Dated 01/04/08 under POWERGRID Document no. D-2-01-03-01-02 will be the reference document. This document will be available at respective sites and shall be referred by the contractor.

TABLE - I (NOT APPLICABLE)

REQUIREMENTS OF 800 KV CAPACITIVE VOLTAGE TRANSFORMERS

S.No.	PARTICULAR			
1.	Rated primary voltage (kV rms)	800		
2.	Type	Single phase capacitor VT		
3.	No. of secondaries	3		
4.	Rated voltage factor	1.2 continuous		
		1.5 - 30 seconds		
5.	Phase angle error	± **10 minutes** (For metering core)		
6.	Capacitance (pf)	4400/8800	+ 10% - 5%	
		Secondary I	Secondary II	Secondary III
7.	Voltage Ratio	$\frac{765}{\sqrt{3}}/\frac{0.11}{\sqrt{3}}$	$\frac{765}{\sqrt{3}}/\frac{0.11}{\sqrt{3}}$	$\frac{765}{\sqrt{3}}/\frac{0.11}{\sqrt{3}}$
8.	Application	Protection	Protection	Metering
9.	Accuracy	3 P	3 P	0.2
10.	Output burden (VA) (minimum)	50	50	50

TABLE-II-A cont'd

REQUIREMENTS FOR 420 KV CURRENT TRANSFORMERS RATED FOR 3000 A

Core No.	Application	Ratio	Output Burden	Accuracy Class	Min. Knee Pt. Voltage (Vk)	Max. CT Sec. wdg. Resistance (in Ω)	Max. Excit. Current at Vk (in mA)
1	BUS DIFF. CHECK	3000/ 2000/ 500/1	-	PS	3000/ 2000/ 500	15	20 on 3000/1 TAP; 30 on 2000/1; 120 on 500/1 tap
2.	BUS DIFF. MAIN	3000/ 2000/ 500/1	-	PS	3000/ 2000/ 500	15	20 on 3000/1 TAP; 30 on 2000/1; 120 on 500/1 tap
3.	METERING	3000/ 2000/ 500/1	20 20 20	**0.2S** **0.2S** **0.2S**	- - -		- - -
4.	TRANS. BACK UP/LINE PROTN.	3000/ 2000/ 500/1	-	PS	3000/ 2000/ 500	15	20 on 3000/1 TAP; 30 on 2000/1; 120 on 500/1 tap
5.	TRANS. DIFF. /LINE PROTN.	3000/ 2000/ 500/1	-	PS	3000/ 2000/ 500	15	20 on 3000/1 TAP; 30 on 2000/1; 120 on 500/1 tap

All relaying CTs shall be of accuracy class PS as per IS:2705

TABLE - IIB (NOT APPLICABLE)

REQUIREMENTS FOR 245 KV CURRENT TRANSFORMERS

No.of Cores	Core No.	Appli-cation	Current ratio	Output burden (VA)	Accuracy class as per IEC: 44-1	Min. knee pt.volt-age (Vk)	Max. CT sec.wdg. resist-ance(ohms)	Max. Excit-ation cur-rent at Vk (in mA)
5	1	BUS DIFF CHECK	1600-800/1	-	-	1600/800	8/4	25 on 1600/1 Tap; 50 on 800/1 Tap
	2	BUS DIFF MAIN	1600-800/1	-	-	1600/800	8/4	25 on 1600/1 Tap; 50 on 800/1 Tap
	3	METERING	1600-800/1	20	0.2S	-	-	-
	4	TRANS. BACK UP/LINE PROTN.	1600-800/1	-	-	1600/800	8/4	25 on 1600/1 Tap; 50 on 800/1 Tap
	5	TRANS. DIFF/LINE PROTN	1600-800/1	-	-	1600/800	8/4	25 on 1600/1 Tap; 50 on 800/1 Tap

All relaying CTs shall be of accuracy class PS as per IS: 2705.

SECTION-3

PROJECT DETAILS & GENERAL SPECIFICATION

SITE INFORMATION

	Particular	Details			
a)	Customer	**Power Grid Corporation of India Limited**			
b)	Project Title	400kV Bay extension at Karaikudi, Pugalur, Kalivanthapattu and Abhishekpatty substation			
c)	Site	Karaikudi	Pugalur	Kalivanthapattu	Abhishekpatty
d)	Name of state	Tamilnadu	Tamilnadu	Tamilnadu	Tamilnadu
e)	Nearest rail head	Karaikudi	Pugalur	Chennai	Tirunelveli
SITE CONDITIONS					
a)	Altitude above sea level	Less than 1000m	Less than 1000m	Less than 1000m	Less than 1000m
b)	Ambient air temp. (Max)	50°C	50°C	50°C	50°C
c)	Special corrosion conditions	No	No	Yes See note below	No
d)	Snow fall	Nil	Nil	Nil	Nil
e)	Seismic zone	As per IS 1893			
f)	Wind zone	As per IS 875 (also see note below)			
g)	Pollution Severity	High Pollution level (25mm/kV)	High Pollution level (25mm/kV)	Very High Pollution level (31mm/kV)	High Pollution level (25mm/kV)

Note:-

Following additional requirements shall be met for Kalivanthapattu substion extension:

1) All switchgears/ equipments, insulator strings, bushings, BPIs shall be designed for minimum creepage distance of 31mm/kV instead of 25mm/kV for other three stations.
2) The rate of zinc coating for galvanized lattice and pipe structures (excluding foundation bolts and fasteners) shall not be less than 900gm/sq. m instead of 610gm/sq. m for other three stations.
3) Outdoor atmosphere around the substation is highly polluted coupled with coastal pollution. Suitable paint and corresponding primers etc. as recommended by paint manufacturer shall be used to withstand the outdoor atmospheric condition.
4) Kalivanthapattu substation falls under high wind zone and basic wind speed shall

be considered as 50m/sec.

1.0 GENERAL

This Chapter covers Technical Requirements and requirements of auxiliary items.

a) Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes unless included in the list of exclusions.

b) Material and components not specifically stated in this specification but which are necessary for satisfactory operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded and shall be supplied at no extra cost.

c) Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition.

d) In case any Deviation Schedule, Bid Proposal Sheet, Schedule of Data Requirements (DRS), test reports or any other document/information are not furnished along-with the bid, the bid is liable to be rejected. Unless brought out clearly, the Bid will be deemed to conform to the specification scrupulously. All deviations from the specification shall be clearly brought out in the respective deviation schedule.

e) Auxiliary supplies as described below would be available at site.

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/Wire	Neutral connection
415V	± 10%	50 ± 5%	3/4 Wire	Solidly Earthed.
240V	± 10%	50 ± 5%	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	-	Isolated 2 wire System
110V	95V to 120V	DC	-	Isolated 2 wire System
48V	_	DC	_	2 wire system (+) earthed

NOTE: Combined variation of frequency and voltage shall be limited to ±10 %.

f) The Bidder shall clearly indicate in the bid, the specific standards in accordance with which the works will be carried out.

g) The equipment must be new, of highest grade, the best quality of their kind, to best engineering practice and latest state of art, and in accordance with purpose for which they are intended and ensure satisfactory performance throughout the service life.

h) All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same materials and workmanship as the corresponding parts of the equipment. Where feasible, common components, units shall be employed in different pieces of equipment in order to optimize the spare part stock-up and utilization.

i) The requirement regarding external RIV as specified for equipment shall include the terminal fittings and the equipment shall have been tested preferably with fittings, if any.

j) All drawings, schedules, annexures appended to this specification shall form part of the specification.

2.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

a) The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc.

b) The equipment shall be able to withstand forces due to wind load, short circuit, system over voltages, fluctuations, frequency variations etc., all forces considered together.

3.0 SUPPORT STRUCTURES

a) The support structures should be hot dip galvanised with minimum 610 gram/m^2 net of zinc.

b) The design calculations taking into account the environmental conditions of the substations shall be furnished for sizing of the structures.

4.0 STANDARDS

a) The equipment to be furnished under this specification shall conform to latest issue with all amendments of standard specified under respective Chapters of this Specification. The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other. The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered

in conjunction with specific IS/IEC. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

b) Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards referred shall also be accepted.

c) In case governing standards for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in additional information schedule alongwith English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Employer's approval.

5.0 ENGINEERING DATA AND OTHER REQUIREMENTS

5.1 The furnishing of engineering data by the Contractor shall be in accordance with the Schedule for each set of equipment as specified in this Technical Specification and the data furnished under the Schedule of Data Requirements (DRS). The review of these data by the Employer will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect overall layout. This review by the Employer may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Employer shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

5.2 All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise explicitly requested by the Employer in Writing.

5.3 The equipment offered shall also comply to the following:-

a) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

b) The reports for all type tests and additional type tests as per technical specification shall be furnished by the Contractor alongwith equipment / material drawings. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accredition body of the country where laboratory is located) or witnessed by the representative(s) of POWERGRID or Utility. The test reports submitted shall be of the tests

conducted within last 5 (five) years prior to the date of bid opening. In case the test reports are of the test conducted earlier than 5 (five) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to the purchaser.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design / manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all additional type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

c) The Purchaser intends to repeat the type tests and additional type tests on Capacitors for which test charges shall be payable as per provision of contract. The price of conducting type tests and additional type tests shall be included in Bid price and break up of these shall be given in the relevant schedule of Bid Proposal Sheets. These Type test charges would be considered in bid evaluation. In case Bidder does not indicate charges for any of the type tests or does not mention the name of any test in the price schedules, it will be presumed that the particular test has been offered free of charge. Further, in case any Bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected.

d) Four (4) copies of all test reports shall be submitted for approval before shipment of equipment. The reports shall indicate clearly the standard values specified for each test, to facilitate checking of the test reports. Six (6) bound copies of test reports shall be submitted after approval of test results.

e) Six (6) copies of documentation of test certificate/ test result alongwith the relevant drawing (wherever applicable) from the raw material stage to final stage as per approved Quality Plan (QP) will be furnished by supplier for each and every equipment immediately after shipment of equipment.

f) 1 RTF and 8 copies of all drawings for each substation plus 6 copies and one RTF of each drawing for corporate office shall be furnished after approval of drgs. 6 copies of instruction/operation manuals for each substation and corporate centre shall also be furnished after approval of manuals.

g) The following program shall be followed for approval of drawings/manuals :

i. Initial comments/approval by Employer within 4 (four) weeks of receipt of drawings.

ii. Resubmission of drawings/manuals within 4 (four) weeks of comments (including both ways postal time).

iii. Approval of drawings/manuals within 3 weeks of receipt of resubmission. Within 21 days of approval, stipulated number of copies and reproducibles in case of drgs shall be furnished by Contractor.

NOTE : The contractor may please note that all resubmissions must incorporate all comments given in the prior submission by the Employer failing which the submission of documents is likely to be returned.

h) Six (6) No. of copies of drawings, Schedule of Data Requirements (DRS) and other documents shall be sent for approval. First submission shall be made within 4 weeks of LOA.

i) All exposed ferrous parts shall be hot dip galvanised as per IS : 2633 & IS : 4579.

j) All current making and breaking contact surfaces shall preferably be silver plated.

k) The equipment name plate/ wiring diagram plate should preferably be of stainless steel. In case of aluminium it should be atleast 2 mm thick. The inscription on the name plate/wiring diagram plate shall be engraved and no punching shall be accepted except for equipment Sr. No. and year of manufacture.

l) Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

m) Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer, if so required.

n) All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor's drawing of work by the engineering shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

6.0 DESIGN IMPROVEMENTS

6.1 The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes, the specification shall be modified accordingly.

6.2 The Bidder should however note that changes proposed by him will have to be supported with applicable type test reports.

6.3 If any such agreed change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

7.0 QUALITY ASSURANCE PROGRAMME

7.1 To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's Works or at his Sub-contractor's premises or at the Employer's site or at any other place of Work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Employer after discussions before the award of Contract. A quality assurance programme of the contractor shall generally cover the following :

a) His organisation structure for the management and implementation of the proposed quality assurance programme.

b) System for Document and Data Control.

c) Qualification and Experience data of Bidder's key personnel.

d) The procedure for purchases of materials, parts components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.

e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control.

f) System for Control of non-conforming products including Deviation Dispositioning, if any and system for corrective and preventive actions based on the feed back received from the Customers and also internally documented system for Customer complaints.

g) Inspection and test procedure both for manufacture and field activities.

h) System for Control of calibration of testing and measuring equipment and the indication of calibration status on the instruments.

i) System for indication and appraisal of inspection status.

j) System of Internal Quality Audits and Management review and initiation of corrective and Preventive actions based on the above.

k) System for authorising release of manufactured product to the Employer.

l) System for maintenance of records.

m) System for handling storage and delivery.

n) A quality plan detailing out the specific quality control measures and procedure adopted for controlling the quality characteristics relevant to each item of equipment furnished and /or service rendered.

o) System for various field activities i.e. unloading, receipt at site, proper storage, erection, testing and commissioning of various equipment and maintenance of records". In this regard, the Employer has already prepared Standard Field Quality Plan for Switchyard Civil Works Document Code No. CC/QA&I/SFQP/SS/03/970905/Rev.1 which is required to be followed for associated civil works. Field Quality Plan pertaining to receipt, storage, erection, testing and commissioning shall be mutually discussed and agreed upon before placement of order.

The Employer or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his vendor's quality management and control activities.

7.2 Quality Assurance Documents

The Contractor shall be required to submit the following Quality Assurance Documents.

i) All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication, and reports including radiography interpretation reports.

ii) Welder and welding operator qualification certificates.

iii) Welder's identification list, listing welder's and welding operator's qualification procedure and welding identification symbols.

iv) Raw Material test reports on components as specified by the specification and/or agreed to in the quality plan.

v) The manufacturing Quality Plan indicating Customer Inspection Points (CIPs) at various stages of manufacturing as mutually agreed upon, and

methods used to verify that the inspection and testing points in the quality plan were performed satisfactorily.

vi) Stress relief time temperature charts.

vii) Factory test results for testing required as per applicable codes/mutually agreed quality plan/standard referred in the specifications.

viii) Stress relief time temperature charts/oil impregnation time temperature charts.

8.0 INSPECTION, TESTING & INSPECTION CERTIFICATE

8.1 The Employer, his duly authorised representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times access to the Contractor's premises or Works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection and if part of the Works is being manufactured or assembled at other premises or works, the Contractor shall obtain for the Employer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. The equipment if found unsatisfactory as to workmanship or material is liable to be rejected.

8.2 The Employer reserves the right to witness any or all type, acceptance and routine tests specified for which at least 30 days notice in advance shall be given by the Contractor. Contractor shall ensure before giving notice for type test that all drawings and quality plans have been got approved. The equipment shall be dispatched to site only after approval of Routine and Acceptance test results and Issuance of Dispatch Clearance in writing by the Employer.

8.3 The Contractor shall give the Employer/Inspector Twenty one (21) days written notice of any material being ready for testing far each stage of testing as identified in the approved quality plan as customer inspection point. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Employer/inspector, unless witnessing of the tests is waived, will attend such tests within Twenty one (21) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector six copies of tests, duly certified.

8.4 The Employer or Inspector shall, within Twenty (21) days from the date of inspection as defined herein give notice in writing to the Contractor, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that

may be necessary to meet the said objections or shall confirm in writing to the Employer/Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

8.5 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Employer/Inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Employer/Inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Employer/Inspector. Failure of the Employer/Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Employer to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract.

8.6 In all cases where the Contract provides for tests whether at the premises or works of the Contractor or of any Sub- Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Employer/Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Employer/Inspector or to his authorised representative to accomplish testing.

8.7 The inspection and acceptance by Employer and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract, or if such equipment is found to be defective at a later stage.

8.8 Material Inspection clearance certificate (MICC) shall be issued by the Employer after inspection of the equipment. Employer may waive off the presence of Employer's inspecting engineer. In that case test will be carried out as per approved QP and test certificate will be furnished by the supplier for approval. MICC will be issued only after review and approval of the test reports.

8.9 The Employer will have the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.

8.10 The Employer reserves the right for getting any field tests conducted on the completely assembled equipment at site.

9.0 ENGINEER'S SUPERVISION

a) To eliminate delays and avoid disputes and litigation it is agreed between the parties to the Contract that all matters and questions shall be referred to the Engineer and without prejudice to the provision of Section GCC, the contractor shall proceed to comply with the Engineer's decision.

b) The work shall be performed under the direction and supervision of the Engineer. The scope of the duties of the Engineer, pursuant to the contract, will include but not be limited to the following :

i) Interpretation of all the terms and conditions of these documents and specifications ;

ii) Review and interpretation of all the Contractor's drawings, engineering data etc. ;

iii) Witness or authorise his representative to witness tests and trial either at the manufacturer's works or at site, or at any place where work is performed under the Contract ;

iv) Inspect, accept or reject any equipment, material and work under the Contract ;

v) Issue certificate of acceptance and/or progressive payment and final payment certificates ;

vi) Review and suggest modifications and improvements in completion schedules from time to time ; and

vii) Supervise the quality Assurance programme implementation at all stages of the Works.

10.0 TESTS

10.1 Charging

a) On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Engineer and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in Chapte-TST and shall be included in the Contractor's quality assurance programme.

The pre-commissioning checks for various Switchyard Equipment shall be in line with the Pre-Commissioning checklist, Document code no. OS/T&C/BAY/95 (Rev. 0). Further, as regards to pre-commissioning checks for Series Capacitors and the overall system including Series Capacitor and other equipment, protection etc., shall be mutually discussed and agreed upon.

b) The Contractor's commissioning engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning

tests. On completion of inspection and checking and after the pre-commissioning tests are satisfactorily over, the complete equipment shall be placed on Initial Operation during which period the complete equipment shall be operated integral with sub- systems and supporting equipment as a complete substation.

10.2 **Commissioning Tests**

a) The available instrumentation and control equipment will be used during such tests and the Engineer will calibrate, all such measuring equipment and devices as far as practicable. However, unmeasurable parameters shall be taken into account in a reasonable manner by the Engineer, for the requirement of these tests.

b) Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

c) The specific tests to be conducted on equipment have been brought out in the Chapter-TST.

10.3 **Test Codes**

The provisions outlines in the IS & IEC codes or other international and Indian approved equivalents shall generally be used as a guide for all the above test procedures unless otherwise specified in the Technical Specifications.

11.0 HANDLING, STORING AND INSTALLATION

a) In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Employer or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the electrical equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

b) Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.

c) In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Employer. Contractor shall be held responsible for any

damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

d) Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.

e) The Contractor shall be fully responsible for the equipment/material until the same is handed over to the Employer in an operating condition after commissioning. Con tractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Employer, as well as protection of the same against theft, element of nature, corrosion, damages etc.

f) Where material/equipment is unloaded by Employer before the Contractor arrives at site or even when he is at site, Employer by right can hand over the same to Contractor and there upon it will be the responsibility of Contractor to store the material in an orderly and proper manner.

g) Contractor shall be responsible for the proper storage and maintenance of all materials/equipment entrusted to him. He shall take all required steps to carry out frequent inspection of material/equipment stored as well as erected until the same is taken over by the Employer.

h) The words 'erection' and 'installation' used in the specification are synonymous.

i) Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

j) Clearances and spacings shall be provided as per relevant IS.

Bidder shall confirm in their technical offer that all clearances and spacing as stated above will invariably be provided. Even though phase to earth clearance under normal conditions will be as above at certain points where there can be bird faults (i.e. a bird sitting on the earthed metal part coming in contact with the HT terminal) adequate clearance as required shall be provided between the HT terminal and nearest grounded metal part.

12.0 TAKING OVER

Upon successful completion of all the tests to be performed at Site on equipment furnished and erected by the Contractor, the Engineer shall issue to the contractor a taking over certificate as a proof of the final acceptance of the equipment. such certificate shall not unreasonably be withheld nor will the Engineer delay the issuance thereof on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

13.0 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with protecting device. All ends of equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

14.0 PRESERVATIVE SHOP COATING

14.1 All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall beforehand be treated and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scale, oxide and other coatings and prepared in the shop. The surfaces that are to be finish painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Transformers and other electrical equipment, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colours shall be selected and specified by the Employer at a later date.

14.2 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 deg.C. shall be selected by the Contractor, after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperatures higher than 95 deg.C. and such primers shall also be subject to the approval of the Employer.

14.3 All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.

15.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

16.0 DESIGN CO-ORDINATION

The Contractor shall be responsible for the selection and design of appropriate equipment to provide the best coordinated performance of the entire system. The basic design requirements are detailed out in this Technical Specification. The design of various components, sub-assemblies and assemblies shall be so done so that it facilitates easy field assembly and maintenance. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical at or close to the operating range of the unit.

17.0 DESIGN CO-ORDINATION MEETING

The Contractor will be called upon to attend design co-ordination meetings with the Employer, other Contractor's and the Consultants of the Employer during the period of Contract. The Contractor shall attend such meetings at his own cost at New Delhi or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

18.0 BUS POST INSULATORS

The post insulators shall conform in general to latest IS:2544, IEC-168 and IEC-815.

CONSTRUCTIONAL FEATURES

18.1 Post type insulators shall consist of a porcelain part permanently secured in a metal base to be mounted on the supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand any shocks to which they may be subjected to by the operation of the associated equipment. Only solid core insulators will be acceptable.

18.2 Porcelain used shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

18.3 Glazing of the porcelain shall be of uniform brown in colour, free from blisters, burrs and other similar defects.

18.4 The insulator shall have alternate long and short sheds with aerodynamic profile. The shed profile shall also meet the requirements of IEC-815 for the specified pollution level.

18.5 When operating at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or insulators by the formation of substance produced by chemical action.

18.6 The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.

18.7 All ferrous parts shall be hot dip galvanised in accordance with the latest edition of IS:2633 and IS :4579. The zinc used for galvanising shall be grade Zn 99.95 as per IS:209. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky white deposits and blisters. The metal parts shall not produce any noise generating corona under the operating conditions.

18.8 If corona extinction voltage is to be achieved with the help of corona ring or any other similar device, the same shall be deemed to be included in the scope of the Contractor.

18.9 **Tests**

The post insulators shall be subject to type, acceptance, sample and routine tests as per IS:2544 and IEC-168.

18.10 TECHNICAL REQUIREMENTS FOR BUS POST INSULATORS

a)	Type	:	Solid Core
b)	Voltage class (kV)	:	420
c)	Dry & wet one minute power frequency withstand voltage (kV rms)	:	680
d)	Dry lightning impulse withstand voltage (kVp)	:	±1425
e)	Wet switching surge withstand voltage (kVp)	:	±1050
f)	Max. radio interference voltage (in microvolts) at voltage of 305 KVrms between phase to ground	:	1000
g)	Corona extinction voltage (kV rms)		320 (Min.)
h)	Total minimum cantilever strength (kg)		800
i)	Minimum torsional moment		As per IEC-273
j)	Total height of insulator (mm)		3650

k)	Pollution level as per IEC-815	Heavy (III)
l)	Minimum total creepage distance for heavy pollution (mm)	10500

19.0 REQUIREMENT OF AUXILIARY ITEMS

19.1 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

a) Bushings shall be manufactured and tested in accordance with IS : 2099 & IEC : 137 while hollow column insulators shall be manufactured and tested in accordance with IEC:233/IS: 5621/IEC:61264, as applicable. The support insulators shall be manufactured and tested as per IS:2544/IEC:168 and IS:2099/IEC:273. The insulators shall also conform to IEC:815 as applicable.

b) Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

c) Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

d) Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

e) When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

f) Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

g) All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

h) **TESTS :**

In accordance with the requirements stipulated, bushings, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS : 2099 & IS : 2544.

i) Parameters of bushings/Hollow column insulators/support insulators :

a)	Rated Voltage	:	420 kV*
b)	Impulse withstand voltage (Dry & Wet)	:	± 1425 kVp*
c)	Switching surge withstand voltage(Dry & Wet)	:	± 1050 kVp*
d)	Power frequency with-stand voltage	:	630 kVrms*
e)	Total creepage distance	:	25mm/kV*
f)	Pollution level	:	Class-III : Heavy (as per IEC-71)

g) Insulator shall also meet requirement of IEC - 815, as applicable, having alternate long & short sheds.

NOTE : * The equipment rating is only indicative. Appropriate rating equipment may be supplied if so required in view of the series capacitor requirement.

19.2 **CONTROL PANELS, RELAY PANELS, CABINETS, JUNCTION BOXES, TERMINAL BOXES, MARSHALING BOXES AND MARSHALING KIOSKS:**

a) All types of boxes, cabinet/panels shall generally conform to IS : 5039, IS : 8623, IEC : 439, as applicable and the clauses given below :

b) Control cabinet/panels, junction boxes, Marshaling box & terminal boxes shall be sheet steel/Al. enclosed and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled/2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of Al. enclosed box the thickness of Al. shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

c) The enclosures of all outdoor type control cabinets/panel, junction boxes, terminal box & marshaling boxes shall provide a degree of protection of not less than IP 55 as per IS : 13947 and the same for indoor type enclosures shall be IP 31 as per IS : 13947and one control cabinet/panel, junction box, terminal box & marshaling box of each type shall be tested for the same, if the type test reports submitted are not to the satisfaction of the owner.

d) Control cabinet/panels, junction boxes, marshaling box & terminal box shall be provided with padlocking arrangements.

e) All doors, removable covers and plates shall be gasketed all around with neoprene gaskets. The neoprene gasket shall be tested in the presence of Employer's representative.

f) All sheet steel work shall be degreased, pickled, phosphated and then applied with two coats of zinc chromate primer and two coats of finishing synthetic enamel paint. The colour of finishing paint shall be light admiralty grey in accordance with shade No. 697 of IS : 5 outside and inside shall be glossy white.

g) All terminal boxes, control cabinet/panels, junction boxes & marshaling boxes shall be designed for the entry of cable from bottom by means of weather proof and dust-proof connections. Boxes and cabinet/panels shall be so designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet/panel. Suitable cable gland plate on the base of the box shall be provided for this purpose. Necessary number of cable glands of suitable sizes shall be supplied and fitted on this gland plate. This removable gasketted gland plate shall have provision for spare glands to be used in future. The glands shall project at least 25 mm above the gland plate to prevent the entry of moisture in the cable crutch. The roof of the outdoor cabinet/panels/boxes shall preferably be of sloping design to prevent stagnation of water.

h) Suitable heaters shall be provided in the cabinet/panel, junction boxes & marshaling boxes to prevent condensation. Heaters shall maintain cubicle temperature approximately 10°C above the outside air temperature. The heaters shall be suitable for 240 V AC supply voltage. On-off switch and fuse for this shall be provided.

i) **Terminal Block :**

All internal wiring to be connected to the external equipment shall terminate on terminal blocks, preferably vertically mounted on the side of cabinet/panel, junction box, terminal box and marshaling box.

The terminal blocks shall be made of moulded, non-inflammable thermosetting plastic. The material of terminal block moulding shall not deteriorate because of varied conditions of heat, cold, humidity, dryness, etc. that would be anticipated at the location where the equipment is proposed to be installed.

The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The terminal blocks shall be non- disconnecting stud type equivalent to Elmex type CAT - M4/CST.

The terminal blocks shall be of extensible design.

The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be of ***650*** V grade and shall be rated to carry continuously the maximum current that is expected to be carried by the terminals.

The terminal blocks used for CT circuits shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulting barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

The terminals shall be provided with the marking tags for wiring identification.

All boxes shall be provided with 20 % spare terminals unless otherwise specified.

j) There shall be a minimum clearance of 250 mm between the first row of terminal block and the cable gland plate or side of the box. Also the clearance between two rows of terminal blocks or side of the box shall be a minimum of 150 mm.

k) The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet/panel is live. Cabinet/panel wiring should be suitable for 60°C as the space heaters will keep the temperature 10°C higher than the ambient.

l) **Wiring :**

All wiring shall be carried out with ***650*** V grade, stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows :
i)All circuits except CT circuits – 1.5/ 0.75.00.4 sq.mm (depending on the device current rating)

ii) CT circuits- 4sq mm; minimum no. of strands shall be 3 per conductor.

iii) Wrapping wires shall be used for electronic rack connection.

All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.

Wire terminations shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires and shall not fall off when the wire is disconnected from terminal blocks.

All wires directly connected to trip circuit breaker shall be distinguished by the addition of a red coloured unlettered ferrule. Number 6 & 9 shall not be included for ferrule purposes.

All terminals including spare terminals of auxiliary equipment shall be wired upto terminal blocks. Each equipment shall have its own central control cabinet in which all contacts including spare contacts from all poles shall be wired out.

A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet/panel with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

For illumination of Control cabinet/panel a 20 Watts Fluorescent Tube/Incandescent Lamp shall be provided.

All control switches shall be of rotary switch type or push button type and toggle/piano switches shall not be accepted.

In accordance with the requirements stipulated under this Chapter control cabinet/panels, junction boxes, terminal boxes & marshaling boxes shall conform to type tests and shall be subjected to routine tests in accordance with IS : 5039. In addition to the type tests, verification of the degree of protection as per IS : 13947, shall be conducted, if the type test reports submitted by the Contractor are not to the satisfaction of the owner. After protection degree tests on control cabinet/panel, power frequency voltage of 2.0 kV rms for 1 minute shall be applied for checking insulation resistance and functional test shall also be conducted.

m) **Earthing :**

Positive earthing of the cabinet/panel shall be ensured by providing two

separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of star or self etching washers. Earthing of hinged door shall be done by using a separate earth wire.

19.3 **MOTORS :**

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall conform to type tests and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

19.4 **TERMINAL CONNECTORS AND CLAMP CONNECTORS :**

The Terminal Connectors of all types shall meet the following requirements:

a) Terminal connectors shall be manufactured and tested as per IS: 5561.

b) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

c) No part of a clamp shall be less than 10 mm thick.

d) All ferrous parts shall be hot dip galvanised conforming to IS: 2633.

e) For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be provided.

f) Flexible connectors shall be made from tinned copper/ aluminium sheets or cables.

g) All current carrying parts shall be designed and manufactured to have minimum contact resistance.

h) Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS: 5561.

i) All test/checks on terminal connectors shall be as per IS: 5561.

19.5 **AUXILIARY SWITCH :**

The type test reports or the following tests on auxiliary switch shall be furnished :

a) Electrical endurance test - A minimum of 2000 operations for 2A DC with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/visual defects/temperature rise test.

b) Mechanical endurance test - A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.

c) Heat run test on contacts.

d) IR/HV test etc.

ANNEXURE-A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1. General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400kV & above) 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) for 132kV above.

2. 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. 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% of 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%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 765kV, 400 kV, 220 KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

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

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

4. 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 values. The test voltage shall be raised to 110% of specified corona

extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and 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%, and 110%. 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 energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

4.1 The test shall be recorded on each photograph. Additional photograph 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 preferably 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 Purchaser's inspector, after determining the best camera locations by trial energisation 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 test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5. Test Records:

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 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) Measurements 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 (for 132kV and above) shall be carried out alongwith supporting structure.

The Bidder shall arrange to transport the structure from his Contractor's premises/POWERGRID 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 Purchaser. 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 Purchaser.

SECTION-4

GUARANTEED TECHNICAL PARTICULARS

Please enclose POWERGRID approved standard Guaranteed technical Particulars for 400kV current Transformer.

SECTION 5

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER

RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

BHEL ENQUIRY. NO:

BIDDER:OFFER REFERENCE:

A)

S.No	Parameters	Data	Yes / No	Remarks
1.	Applicable Standard	IEC: 60044-1, IS-2705	Yes	
2.	Type	Outdoor	Yes	
3	Rated Frequency	50 Hz	Yes	
4	Highest System Voltage	420kV	Yes	
5	Rated current	3000A	Yes	
6	Rated short time withstand current for 1 sec	40 kA for 1 sec.	Yes	
7	Rated extended current	120%	Yes	
8	Rated dynamic current	100kAp	Yes	
9	Type of Insulation	Class A	Yes	
10	Rated Insulation Levels : a. Power Freq. Withstand Voltage b. Lightning Impulse withstand voltage	630kV (rms) 1550kVp	Yes	
11	Creepage Distance	10500 mm for Karaikudi,Pugalur & Abhishekpatty S/S 13020 mm for Kalivanthapattu S/S	Yes	
12	The CT Core Parameters	As per Clause 1.2 c of Section I	Yes	
13	CT supplied Suitable for operation in the Climatic and High Altitude conditions.	Suitable for Climatic and Meteorological Data Specified in Section III	Yes	
14	Max. Temperature rise over design ambient temperature	As per IEC 60044-1 & IS 2705	Yes	

15	External Surface if steel	a. Hot Dip Galvanized b. Painted	Yes	
16.	Standard drawings & GTP.	POWERGRID approved standard drawings / GTP of the offered CT type available . POWERGRID approval Letter comprising list of approved drgs & GTP to be attached with offer.	Yes,	
17.	Type Test report approval Extension.	PGCIL Approval Letter comprising list of test reports to be submitted along with offer.	Yes	
18	Technical Requirement	Manufacturer qualifies the Technical Requirement as per clause 1.10 of Section-I of the Technical Specification.	Yes	

B) TYPE TESTS

i)Whether type test reports of the tests as per relevant IS-2705 and IEC 60044 conducted earlier on identical or similar material are available(test reports are of the test conducted not earlier than 10 (ten) years prior to the date of LOA i.e. 28/06/13). However, the following type tests should have been conducted within 5 (five) years prior to the date of LOA.

i) Lightning Impulse Test
ii) Switching Impulse Test
iii) Multiple Chopped Impulse Test (For CT) **(YES)**

ii) If type test reports are not acceptable to BHEL/PowerGrid then above tests shall be conducted by the bidder free of cost. **(YES)**

Date:

Signature of the authorized representative of Bidder

Company Seal