BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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TYPE OF DOC.	TECHNICAL SPECIFICATION			NAME	RD	VK	VK
TITLE	765kV CAPACITIVE VOLTAGE TRANSFORMER			SIGN			
				DATE	14/06/19	14/6/19	
				GROUP	TBEM	W.O. No	86009
CUSTOMER	Tamilnadu Transmission Corporation Limited (TANTRANSCO)						
PROJECTS	765/400kV AIS S/S Ariyalur						

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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 Capacitive Voltage Transformers complete with accessories as listed below. This section covers the specific technical requirements of 765kV CVT.

The specification comprise of following sections:

Section-1:	Scope, Specific Technical Requirements & Bill of Quantities
Section-2:	Equipment Specification
Section-3:	Project Details & General Technical Requirements
Section-4:	Guaranteed Technical Particulars
Section-5:	Checklist

In case of any conflict between various sections, **order of precedence** shall be in the same order as listed above.

Note: The terms used in this specification namely, "Employer/Purchaser" refers to TANTRANSCO and "Contractor/manufacturer" refers to successful bidder.

1.1 The equipment is required for the following Project:

Name of Customer: Tamilnadu Transmission Corporation Limited (TANTRANSCO)

Name of the Project: 765/400kV AIS S/S Ariyalur

Refer Section - 3 for Project Details and General Specifications.

2.0 SPECIFIC TECHNICAL PARTICULARS

a. Technical Parameters of 765kV CVT:

Sl. No.	Description of parameters	Data
1.	Max. System Voltage	800kV
2.	System Fault Level	50 kA for 1(one) Sec
3.	Rated frequency	50 Hz
4.	Min. Creepage Distance	25 mm/kV

b. CVT Winding Parameters:

i) 765kV CVT (TYPE-I):

Ratio	$\frac{765KV}{\sqrt{3}} / \frac{110V}{\sqrt{3}} / \frac{110V}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$
Sec-I	Class – 3P, 50VA
Sec-II	Class – 3P, 50VA
Sec-III	Class – 0.2, 50VA
	Capacitance: 4400 pF (+10% , -5%)

ii) **765kV CVT (TYPE-II):**

Ratio	$\frac{765KV}{\sqrt{3}} / \frac{110V}{\sqrt{3}} / \frac{110V}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$
Sec-I	Class – 3P, 100VA
Sec-II	Class – 3P, 100VA
Sec-III	Class – 0.2, 100VA
	Capacitance: 4400 pF (+10% , -5%)

For detailed Technical requirements refer Section-2 of the technical Specification

3.0 TECHNICAL REQUIREMENTS:

3.1 The manufacturer(s) whose 765kV Capacitive Voltage Transformer(s) are offered, should have designed, manufactured, type tested (as per IEC/IS) and supplied 715kV or above class Capacitive Voltage Transformers, which are in satisfactory operation for at least two (2) years as on 31.03.2017.

The manufacturer for 765kV class Capacitive Voltage Transformers should have repair and maintenance facilities for these equipments in India. The repair and maintenance facilities shall be such that the equipment can be repaired and maintained without necessitating it to be taken outside the country. In case the manufacturer is not having these facilities and the offered Capacitive Voltage Transformers are from outside India, the manufacturer should have Repair & Maintenance facilities in India as on 31.03.2017, otherwise he shall be required to supply 5% of total quantity, rounded off to the next higher integer, subject to a minimum of 3 Nos. of each type and rating of Capacitive Voltage Transformers as additional spares (excluding mandatory spares) in lieu of repair and maintenance facilities for 765 kV Capacitive Voltage Transformers.

OR

3.2 765kV Capacitive Voltage Transformers may also be offered from the manufacturer, who have established production line in India and have manufactured & type tested (as per IEC/IS) 715kV or above Voltage Class Capacitive Voltage Transformers, manufactured in their Indian works, which are in satisfactory operation as on 31.03.2017. In case the above Capacitive Voltage Transformers are not in satisfactory operation for two (2) years as on 31.03.2017, the manufacturer shall furnish performance guarantee for an amount of 10% of the ex-works cost of the Capacitive Voltage Transformers. This performance guarantee shall be in addition to the contract performance guarantee to be submitted by the manufacturer.

The manufacturer for 765kV class Capacitive Voltage Transformers should have repair and maintenance facilities for these equipments in India. The repair and maintenance facilities shall be such that the equipment can be repaired and maintained without necessitating it to be taken outside the country. In case the manufacturer is not having these facilities and the offered Capacitive Voltage Transformers are from outside India, the manufacturer should have Repair & Maintenance facilities in India as on 31.03.2017, otherwise he shall be required to supply 5% of total quantity, rounded off to the next higher integer, subject to a minimum of 3 Nos. of each type and rating of Capacitive Voltage Transformers as additional spares (excluding mandatory spares) in lieu of repair and maintenance facilities for 765 kV Capacitive Voltage Transformers.

4.0 PRE-COMMISSIONING AND COMMISSIONING

All pre-commissioning tests as per approved field Q.P and Instructions of equipment supplier shall also be performed without any extra cost to BHEL / Customer. The bidder shall arrange all special instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments for approval. "Commissioning checks", "installation checks","Site tests" wherever mentioned in the Specification shall be considered as pre-commissioning checks.

Note: The respective dates of commencement of erection, pre-commissioning and commissioning activity by BHEL will be intimated to the equipment manufacturer from time to time, so that arrangements for supervising the activity can be made accordingly by the manufacturer (However, the travel, lodging and boarding expenses for each visit of the bidder's engineers shall be borne by the bidder).

5.0 BILL OF QUANTITY:

765/400kV AIS S/S Ariyalur

Sl. No.	Description	Unit	Quantity
1.	765kV, 1ph, 3 secondary, 4400pF CVT **(TYPE-I)**	No.	12
2.	765kV, 1ph, 3 secondary, 4400pF CVT **(TYPE-II)**	No.	6
3.	Supervision of Erection for items under Sl. No. 1 above	Lot	1
4.	Supervision of Erection for items under Sl. No. 2 above	Lot	1
5.	Supervision of Testing (or Pre-Commissioning) for items under Sl. No. 1 above	Lot	1
6.	Supervision of Testing (or Pre-Commissioning) for items under Sl. No. 2 above	Lot	1
7.	Supervision of Commissioning for items under Sl. No. 1 above	Lot	1
8.	Supervision of Commissioning for items under Sl. No. 2 above	Lot	1

Note:

1. The Quantity is subject to change by ±20%.
2. Hardware (Nut, Bolts and Washers) for Mounting CVT on structure – 1 set for each CVT to be included by bidder in their offer.
3. BHEL shall procure support structure, terminal clamps & connectors and Junction Box separately.
4. Multiple visits are envisaged for each lot against Sl. No. 3 to 8 above.

6.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

a. All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under Clause 3.0 of section-2.

b. The reports for all type tests as per technical specification shall be furnished by the bidder along with equipment / material drawings. However, type test reports of similar equipments/ material already accepted in TANTRANSCO shall be applicable for all project with similar requirement. 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 accreditation body of the country where laboratory is located) or witnessed by TANTRANSCO or representative authorized by TANTRANSCO or Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 5 (five) years prior to 30.09.2016. In case the test reports are of the test conducted earlier than 5 (five) years prior to 30.09.2016, the bidder shall repeat these test(s) at no extra cost to BHEL.

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, the same shall be carried out without any additional cost implication to the Purchaser.

The supplier shall intimate BHEL/TANTRANSCO the detailed program about the tests at least two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

In case type tests are to be conducted /repeated and deputation of Inspectors/Purchasers representative is required, then all expenses shall be borne by Bidder.

7.0 SPECIAL TOOLS AND TACKLES:

The bidder shall include in his proposal the deployment of all special tools and tackles required for erection, testing, commissioning and maintenance of the equipment. The **Special tools and tackles shall only cover items which are specifically required for the equipment offered and are proprietary in nature.** A list of all such devices shall be furnished. In addition to this the bidder shall also furnish a list of special tools and tackles required to be used during the operation of the equipment.

8.0 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.

9.0 A legally enforceable undertaking shall be furnished by the L-1 Bidder to guarantee quality, timely supply and performance of the 765 kV Capacitive Voltage Transformers and that Erection, testing and commissioning of 765kV class Capacitive Voltage Transformers shall be carried out under the supervision of 765kV Capacitive Voltage Transformers manufacturer.

SECTION-2

CAPACITIVE VOLTAGE TRANSFORMER

1.0 The design, materials, construction, manufacture, inspection and testing of Capacitive Voltage Transformer shall comply with all currently applicable statutes, regulations and safety code in the localities where the equipments will be installed. The equipment shall conform to the latest applicable standards. ~~The CVT to be supplied along with suitable lattice support structure~~.

2.0 The Capacitive Voltage Transformers and accessories shall conform to the latest editions of Standards.

3.0 SALIENT FEATURES OF CAPACITANCE VOLTAGE TRANSFORMER

SL.No	DETAILS	UNIT	765KV system	400KV System
1.	System rated voltage	KV rms	765	~~400~~
2.	System Highest Voltage	KV rms	800	~~420~~
3.	Rated Frequency	Hz	50	~~50~~
4.	System Fault Level	KArms	50(1sec)	~~63(1sec)~~
5.	System neutral Earthing		Effectively Earthed	~~Effectively Earthed~~
6.	Voltage Factor -Continuous -for 30 seconds		 1.2 1.5	 ~~1.2~~ ~~1.5~~
7.	Insulation Level			
i)	1.2/50 microseconds Impulse Withstand Voltage	KV (Peak)	**2100**	~~1425~~

ii)	250/2500 microseconds Switching Impluse withstand voltage	KV (Peak)	1550	~~1050~~
iii)	1 minute dry power frequency withstand Voltage	KV rms	975	~~630~~
iv)	(LV Side) Between LV(HF) terminal and earth			
	-for exposed terminals	KV rms	10	~~10~~
	-for terminals enclosed in weather proof enclosure	KV rms	4	~~4~~
8.	Maximum Radio Interference Voltage. For freq. between 0.5 to 2 mhz	Micro volt	2500 (at 508KVrms)	~~1000 (at 320KVrms)~~
9.	Minimum corona extinction voltage	KVrms	508	~~320~~
10.	Partial Discharge Level	(Pico Coulombs)	As per IEC	~~10~~
11.	Standard reference range of frequencies for which the accuracies are valid			
	-protection	%	96 to 102	~~96 to 102~~
	-metering	%	99 to 101	~~99 to 101~~
12	High frequency capacitance for entire carrier frequency range	%	80 to 150% of rated capacitance	~~80 to 150% of rated capacitance~~
13	Equivalent resistance over entire carrier frequency range	Ohms	<40	~~<40~~

14	Stray capacitance and stray conductance of LV terminal over entire carrier frequency range		As per IEC 60358	~~As per IEC 60358~~
15	Cantilever Strength	Kg	500	~~500~~

2.0 TECHNICAL PARTICULARS:

Rated Voltage Rating Burden & Accuracy
Installation and Type : Outdoor, single phase, capacitor type suitable for upright mounting on steel or RCC support.

Coupling capacitance values for the CVTs are as follows

(Rated Capacitance) 765 kV CVT: 4400 pf (+10,-5%)

~~400 kV CVT: 4400 pf (+10,-5%)~~

Winding No.	Rated voltage ratio	Rated Burden	Accuracy	Purpose
I	765/√3KV / 110/√3 V	50 VA *	3P	Main I protection + Under Impedance Protection
II	765/√3KV / 110/√3 V	50 VA *	3P	Main II protection +Under Impedance Protection
III	765/√3KV / 110/√3 V	~~300~~ VA 50 *	0.2	Metering

* BURDEN VALUES MENTIONED FOR TYPE-I CVT IN THE TABLE. FOR TYPE-II CVT, BURDEN VALUES SHALL BE 100 VA, OTHER PARAMETERS IN THE TABLE REMAINING SAME.

Winding No.	Rated voltage ratio	Rated Burden	Accuracy	Purpose
I	400/√3KV / 110/√3 V	50 VA	3P	Main I protection + Under Impedance Protection
II	400/√3KV / 110/√3 V	50 VA	3P	Main II protection +Under Impedance Protection
III	400/√3KV / 110/√3 V	300 VA	0.2	Metering

GENERAL REQUIREMENT

a) 800~~/420~~ KV voltage transformer 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 and. 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 following into potential transformer (EMU) circuit by means of a RF choker/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 brought out through a suitable brushing and shall be easily accessible for connection to the coupling filters of the carrier communication equipment, when utilized. 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 ferro resonance oscillations.

f) The accuracy of 0.2 on secondary III should be maintained throughout the entire burden range up to 100 VA on all the windings without any adjustments during operation.

g) 800/~~420~~KV CVTs shall be suitable for mounting on lattice support structure.

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 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 shout circuit in transformer secondary being 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.

k) The winding material should be of copper.

3.0 TESTS:

Voltage Transformers should have been type tested and shall be subjected to routine tests in accordance with IEC- 44-1/IS: 2705 and IEC: 186/IS: 3156 respectively.

i) High frequency capacitance and equivalent series resistance measurement (as Per) (IEC 358)
ii) Seismic withstand test.
iii) Stray capacitance and stray conductance measurement of the low voltage terminal (as Per IEC 358)
iv) Determination of temperature co efficient test (as per IEC 358)
v) Ratio interference test
vi) The Ferro-resonance type test shall be carried out on the complete CVT.

in case of instrument transformers, the following type tests should have been conducted within 5 (five) years prior to the originally scheduled date of bid opening, i.e., 30/09/2016.

i) Lightning Impulse Test
ii) Switching Impulse Test
iii) ~~Multiple Chopped Impulse Test (For CT)~~
iv) Chopped Impulse Test (For CVT)

4.0 SITE TEST

i) Capacitance and loss angle measurement before and after voltage test (as per IEC: 358).

ii) Partial discharge test on capacitor dividers (as per IEC 358).

iii) Sealing test (as per IEC – 358).

5.0 TECHNICAL PARAMETERS

5.1 System faults level 50KA for 1 sec for 765KV system ~~63 kA for 1 sec for 400KV system~~.

5.2 Standard reference range of frequencies for which the accuracies are valid are 96% to 102% for protection and ~~Which the accuracies are valid~~ 99% to 101% for measurement

5.3 High frequency capacitance for entire carrier frequency range shall be within 80% and 150% of rated ~~Frequency range~~ capacitance

5.4 Equivalent series resistance over the entire Carrier frequency range less than 40 ohms.

5.5 Stray capacitance and stray conductance of AS per IEC 358

The LV terminal over entire carrier freq. range.

5.6 One minute power frequency withstand Voltage

i) Between LV (HF) terminal and earth 10 KV (rms for exposed

Terminal terminals and 4 KV(rms) for terminals enclosed in a weather proof box

ii) for secondary winding 3 KV (rms)

5.7 Maximum temperature rise over design

Ambient temperature As per IEC: 186

5.8 Number of terminals in control cabinet All terminals of are wired (For Inter-pole cabling is to be supplied upto marshalling box along with CVT) plus 12 terminals exclusively for purchaser's use (MARSHALLING /JUNCTION BOX NOT IN SCOPE OF BIDDER)

5.9 Rated total thermal burden (VA) 300

SECTION – 3

GENERAL TECHNICAL REQUIREMENTS

3.0 FOREWORD

The provisions under this section are intended to supplement general requirements for the materials, equipment's and services covered under other sections.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a) Customer : M/s Tamil Nadu Transmission Corporation Limited

b) Project Title : 765/400KV AIS SUB STATION AT ARIYALUR

c) Transport facilities : Road/Rail

Physical and other parameters:

3.1.1 Location of the substation

3.1.2 Nearest Railway station : Tindivanam
Railway : Southern Railway

3.1.3 Meteorological data

(i)	Atmosphere	: Polluted
(ii)	Maximum ambient temperature	: 50°C
(iii)	Minimum ambient temperature	: 20°C
(iv)	Maximum daily average ambient air temperature	: 45° C
(v)	Maximum yearly average ambient air temperature	: 32° C
(vi)	Maximum Humidity (%)	: 100%
(vii)	Average thunder storm days per annum	: 50
(viii)	Average rainy days per annum	: 65
(ix)	Average annual rainfall (mm)	: 750 mm
(x)	No. of months during which tropical monsoon condition prevail	: 3
(xi)	Maximum wind pressure	: 150 Kgf/Sqmm
(xii)	Altitude above MSL	: <1000M

(xiii) Basic Wind Speed : **47 m/s (Zone -4)**

However for design purpose, ambient temperature should be considered as 50° C and relative humidity as 100%.

3.1.4 System Parameter

SL No	Description of parameters	765kV System	400 kV System
1.	System operating Voltage	765kV	400k V
2.	Maximum operating voltage of the system(rms)	800kV	420k V
3.	Rated Frequency	50HZ	50H
4.	Number of Phases	3	3
5.	Rated Insulation Levels (i)Full wave impulse withstand voltage.(1.2 to 50 micro sec) (ii)Switching impulse withstand voltage(250/2500 micro sec) dry and wet. (iii) One minute power frequency dry withstand voltage (rms)frequency dry withstand voltage (rms)	 2100kVp 1550kVp 830kV	 1550kVp 1050kVp 630kV
6.	Corona extinction voltage	508kV	320kV
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 508 kV rms for 765kV,and 266kV rms for 400kV system	2500 microvolts	1000 microvolts
8.	Minimum creepage distance (25mm/kV)	20000 mm	10500 mm
9.	Rated short circuit current for 1 sec. Duration	50kA	63kA
10.	System neutral earthing	Effectively earthed	Effectively earthed
11.	Seismic acceleration	0.3g horizontal	0.3g horizontal
12.	Plinth level of switchyard	500mm above FGL	500mm above FGL

3.1.5 AUXILIARY POWER SUPPLY :

Auxiliary electrical equipment's maintenance equipment's etc., shall be suitable for operation on the following supply system.

3 phase AC Supply	415V, 3 phase 4 wire 50 Hz, neutral grounded AC supply -10% to +10%, frequency +/- 5%
1 phase AC supply	240V, single phase, 50 Hz neutral grounded AC supply
DC supply	220, 2 wire DC supply + 10% to –15%, Ungrounded 48V, 2 wire DC supply , Positively earthed

3.2 GENERAL REQUIREMENT

3.2.0 ALL THE EQUIPMENTS / MATERIALS TO BE SUPPLIED SHOULD BE IN ACCORDANCE WITH RELEVANT LATEST / AMENDED IS/IEC, WHETHER IT HAS BEEN SPECIFICALLY MENTIONED IN THE SPECIFICATION OR NOT.

3.2.1 The bidder shall also furnish drawings for the following:

All EQUIPMENTS and type of clamps, fittings hardware's, insulators, bus bar. These designs / drawing shall be got approved by the purchaser before commencing the manufacture / construction / erection and are to be as per latest IS /IEC.

3.2.2 **GENERAL**:

The bidder shall be fully responsible for providing all equipment, materials system and services specified or otherwise which are required to complete the construction and successful commissioning of the substation in all respects.

Any other items not specifically mentioned in the specification but which are required for erection of materials/equipment under the scope of work, testing and commissioning are deemed to be included in the scope of the specification unless specifically excluded.

All items shall be supplied as per schedule and as specified in the relevant Indian standard of latest revision. The Technical specification of the main materials/equipment is furnished. The Technical specification contained herein for the materials are for the guidance of the tenderer.

The bidders are requested to procure the equipment's/materials/component only from reputed /qualified manufacturer as per Technical requirement stipulated in Section - I of Technical specifications. Approval of make of item shall be taken up by vendor from TANTRANSCO himself.

3.3 SPECIFIC REQUIREMENT

The bidder shall furnish make/manufacturer, catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification and get approval from competent authority before commencement of any work.

All steel materials, other than materials for earthing should be of galvanized if not specified.

3.4 STANDARD:

The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the date of bid opening) of standards specified in each section.

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 Bidder 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.

3.5 TYPE TEST:

The Type Test for all the equipments/materials used for this project should have been conducted in any approved Government/Govt. recognized laboratories conforming to latest IS/IEC. The above type test certificates should accompany the drawings of the materials equipments, duly signed under seal by the Institution, who have issued the type test certificate. The above type test should have been conducted not earlier than Ten years, subject to no change in design as on the originally scheduled date of technical bid opening i.e. **30.09.2016**

In case the type tests were conducted earlier than 10 (ten) years prior to the originally scheduled date of bid opening, the contractor shall repeat these test (s) at no extra cost to the purchaser.

However, in case of instrument transformers, the following type tests should have been conducted within 5 (five) years prior to the originally scheduled date of bid opening.
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 (for instrument transformers) asmentioned above are conducted earlier than 5 (five) years prior to the originally scheduled date of bid opening, the contractor shall repeat these test(s) at no extra cost to the BHEL. The original type test certificates shall be furnished for verification on request.
TANTRANSCO/BHEL reserves the right to demand repetition of some or all the type tests in the presence of purchaser's representative at no extra cost.
Non furnishing of type test certificates by the tenderers, will be liable for rejection.

3.6 MATERIALS AND WORKMANSHIP:

All the materials shall be of the best class and capable of satisfactory operation in the tropics with humid atmosphere conditions. Unless otherwise specified, they shall conform to the requirements of the appropriate ISS/IEC. The workmanship shall be of the best grade and the entire construction in accordance with the best modern practice.

The equipment shall be designed to facilitate inspection and repairs and to ensure satisfactory operation under atmosphere condition prevailing at site and under such sudden variation of load and voltage as may be met with under working conditions in the system including those due to faulty synchronizing and short circuit within the rating of the apparatus.

The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the equipment.

All the equipment's should operate without undue vibration and with the least practicable amount of noise.

3.7 **INSPECTION** :

The inspection may be carried out by the TANTRANSCO/BHEL at any stage of manufacture. The supplier shall grant free access to TANTRANSCO's/BHEL representative at a reasonable time when the work is in progress. The TANTRANSCO/BHEL shall have access at all times to the works and all other places of manufacture/fabrication, where the equipments are being manufactured/fabricated and the bidder shall provide TANTRANSCO's/BHEL representative all facilities for unrestricted inspection of the works, raw materials, manufacture of all the accessories and for conducting necessary tests.

Inspection and acceptance of any equipment under this specification by the TANTRANSCO/BHEL shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective. The supplier shall keep the TANTRANSCO/BHEL informed in advance, about the manufacturing programme so that arrangement can be made for inspection.

The TANTRANSCO/BHEL, reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

The correct grade and quality of steel shall be used by the supplier. To ascertain quality of steel, the TANTRANSCO/BHEL may at his discretion get the material tested at an approved laboratory.

The bidder shall take an account the fabrication wastage while quoting the rates. The Employer will not accept any liability in connection with the wastage of steel during fabrication or otherwise. Steel shall be procured exclusively from the main producers. However, sections not rolled by main produces can be procured from reroller, provided rerolling of structural steel section is done rom billets/ingots of tested quality. Rerolled sections are duly tested as per relevant standards. Supplier should obtain approval of list of primary producers of Steel and Zinc before Proto assembly.

The BHEL/TANTRANSCO or his representative shall have the right to inspect and/or test the goods /works to confirm their conformity to the supplier. BHEL/TANTRANSCO shall notify the supplier in writing of the identity of any representatives authorized for these purposes.

The inspections and tests may be conducted on the premises of the supplier or his Sub vendor at the point of delivery and /or at the goods' final destination. Where tests are conducted in the premises of Supplier, all reasonable facility and assistance including access to drawings and production data shall be furnished at no charge to the BHEL.

Should any inspected or tested goods fail to conform to specifications, the BHEL/TANTRANSCO may reject them and the supplier shall either replace the rejected goods or make all alterations necessary to meet specification requirements free of cost to the BHEL/TANTRANSCO within one week of intimation.

The BHEL/TANTRANSCO's right to inspect, test and where necessary reject the goods after the goods; arrival at the site, shall in no way be limited or waived by reason of the goods having been previously inspected. Tested and passed by the BHEL/TANTRANSCO or his representative prior to the goods dispatch.

Not less than 15 (Fifteen) days advance intimation shall be given about the quantity of materials that will be ready for inspection by the officers of TANTRANSCO/ BHEL/Third agency authorized by the Corporation. The materials should not be dispatched without instruction from the Corporation.

3.8 GUARANTEE:

The supplier shall guarantee that the goods under the Contract are new, unused of the most recent or current models and incorporated all recent improvements in design and materials unless provided otherwise in the Contract. The supplier shall further guarantee that the goods supplied under this Contract shall have no defects arising from design, materials or workmanship, installation and erection, if that may develop under normal use of the supplied goods. The supplier shall also guarantee the performance of the works executed by him including the performance of all the materials/goods supplied by him.

BHEL shall promptly notify supplier in writing of any claims arising under guarantee in respect of goods. Upon receipt of such notice, the supplier shall, with all reasonable speed, repair or replace the defective works or parts thereof, free of cost at site. All the expenses towards transportation of defective parts to supplier's works and of repaired/replaced parts to site shall be borne by the Supplier.

If the Supplier, having been notified, fails to remedy the defects within 14 days, the BHEL will proceed to take such remedial action as may be necessary, at the supplier's risk and expenses. All expenses in this regard will be recovered from Supplier.

3.9 PRE COMMISSIONING TESTING (if applicable) :-

On completion of erection of equipment's and before charging each item of equipment's shall be thoroughly cleaned and inspected jointly by the TANTRANSCO and the BHEL for correctness and completeness of installation and acceptability for charging leading to initial pre commissioning test. The pre commissioning testing to be carried all equipment's in the presence of BHEL/ TANTRANSCO. Necessary tools, testing kits to be arranged by the Supplier.

3.10 DOCUMENTATION : All drawings shall conform to relevant international standards Organization (ISO) specification. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. units.

3.11 PAINTING, GALVANISING:

All interiors and exteriors of all metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter and the surfaces treated by phosphating (e.g. seven tank phosphating sequences).

All metal surfaces exposed to atmosphere shall be given, in addition to the treatment, two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limits specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external paintings shall be as per shade **No.697/631 of IS-5**.

Paint inside the metallic housing shall be of anti condensation type and the paint on outside surfaces shall be suitable for outdoor installation.

All components shall be given adequate treatment of climate proofing as per **IS: 3202** so as to withstand corrosive and several service conditions.

All ferrous parts including all sizes of nuts, bolts, support channel structures, etc. as also the mechanism housing shall be hot dip galvanized conforming to latest version of IS : 2629 or epoxy painted. Spring washers shall be electro-galvanised.

All members of the structure members shall be hot dipped galvanised with a zinc coating of **610 gms. per square metre** . Galvanising shall be done after a work is completed, except that the nuts may be tapped or rerun after galvanization. The zinc coating shall be smooth, clean, of uniform thickness and free from defects. The preparation for galvanising itself shall not adversely affect the mechanical properties of the coated materials. The employer shall be at liberty to have the samples of zinc used, test checked in any laboratory at his own cost and reject the particular supply if it is below standard.

All galvanised material shall withstand test as per IS 2633-1972 or any other equivalent standard.The zinc used for galvanising fabricated material shall be of high grade Electrolytic zinc of 99.99% purity.

All nuts and pins shall be adequately locked. Nuts, bolts and pins used inside the transformer and tap-changer compartment where gaskets are not used shall be provided with spring washers or locknuts. Where galvanizing is specified, it shall be applied by the hot dipped process or by electro-galvanizing process and for all parts, other than steel wires, shall consist of a thickness of zinc coating equivalent to not less than 610gm of zinc per square meter of surface. The zinc coating shall be smooth, of uniform thickness and free from defects.

3.12 **SURFACE FINISH**

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

3.13 **PROTECTION**

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.14 **FUNGI-STATIC VARNISH**

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.