



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS HVDC ENGINEERING & SYSTEMS

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TYPE OF DOC.	TECHNICAL SPECIFICATION	SIGN				
TITLE		NAME	NS	SKS	AG	
	33kV Current Transformer	DATE	29/05/2020	29/05/2020	29/05/2020	
		GROUP	HVDC	W.O. No	Awaited	
CUSTOMER	POWERGRID FATEHGARH TRANSMISSION LIMITED- A 100% wholly owned subsidiary of Power Grid Corporation of India Limited					
PROJECT	Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route					
NOA NO.	FTL/765kV/SS02/NOAI/2(I) For Supply of Goods Contract Dated 05-11-19 & FTL/765kV/SS02/NOAII/2(II) For Supply of Service Contract Dated 05-11-2019					
Station	Fatehgarh-2, Rajasthan					
CONTENTS						
Section	Description					No of Sheets
1	Scope, Bill of Quantity, Specific Technical Requirement					4
2	Equipment Specification					3
3	Project Details and General Technical Requirements					35+2+1+13+3
4	Checklist					2
Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS	
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Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00

SECTION-1

Scope, Bill of Quantity, Specific Technical Requirements

1.1 Scope

This technical specification covers the requirements of design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to site of 33kV Current Transformer complete in all respect for efficient & trouble free operation mentioned under this specification.

The equipment is required for the following project:

Name of the customer : **POWERGRID FATEHGARH TRANSMISSION LIMITED- A 100% wholly owned subsidiary of Power Grid Corporation of India Limited**

Name of the project : **Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route**

Site : **Fatehgarh-II, Rajasthan**

***Note: The terms used in this specification namely, "Employer" refers to PowerGrid , "POWERGRID" refers to BHEL/POWERGRID, "Contractor" refers to Bidder, "GTR" refers to "section-3".**

In case of any conflict among the various sections of this specification, the order of precedence shall be section 1, section 2 & the section 3.



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

1.2 Bill of Quantities

1.2.1 Main Supply:

S. No.	Item Description	Unit	Quantity
			Fatehgarh II
1	SUPPLY- 33kV Neutral CT for bank of Reactor	Nos.	2

Notes –

1. The CT's shall be complete with Hardware (Nut, Bolts and Washers) for Mounting CT on structure. One (1) set for each CT to be included by bidder in their offer.
2. The above quantities are subject to change by $\pm 10\%$ at contract stage.
3. The Maximum magnetization current to be considered at $V_k/4$ for Reactor Neutral CT (V_k =knee-point voltage).

1.3 Specific Technical Requirements

1.3.1 Technical Parameters - 33kV Neutral CT for Bank of Reactor

S.No	Description of parameters	For Reactor
1.	Nominal system voltage (kV)	33
2.	Minimum knee Point voltage (V_k)	300
3.	Maximum CT Resistance(Ω)	1.0
4.	Max. Mag.current at $V_k/4$ (mA)	40
5.	Rated Frequency	50
6.	Current Ratio (A)	300/1
7.	Accuracy Class	PX / PS



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

8.	Highest System Voltage (kV)	36
9.	S.C Rating	25kA/3sec
10.	Creepage (mm/kV)	25
11.	Full wave impulse withstand voltage (1.2/50 microsec.) (kVp)	170
12.	One minute power frequency dry and wet withstand voltage (rms) (kV)	70
13.	Minimum Creepage Distance (mm)	900
14.	Rated extended current	120%

For other parameters, refer respective section 2.

1.3.2 Type Tests

- i. 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 respective sections.
- ii. 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 POWERGRID shall be applicable for all projects 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 POWERGRID or representative authorized by POWERGRID or Utility or representative of accredited test lab.

Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted on or after 05-Nov-2009. In case the test reports are of the test conducted earlier than 05-Nov-2009, the bidder shall repeat these test(s) at no extra cost to the BHEL/Employer.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

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 BHEL/Employer.

The Bidder shall intimate the Employer/BHEL the detailed program about the type tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

- iii. The Employer reserves the right to witness any or all the type tests. The Employer shall bear all expenses for deputation of Employer's representative(s) for witnessing the type tests.
- iv. The list of makes of various items, for which Type test reports are not required to be submitted are specified in Compendium of Vendors (COV).

1.3.3 Drawings & Engineering Documents

The successful bidder shall have to extend all possible supports like timely submission/resubmission of drawings, visit to end customer to facilitate documents approval without any commercial implications to BHEL. Acceptance of bidder's documents shall be subject to end customer approval.

Date of Submission of first lot of drawings will be counted only from the date of submission of reasonably correct drawings. List of drawings required for technical clearance of manufacturing are as follows:

1. Approved GTP
2. Approved GA Drawing.
3. Approved Type Test Reports.

1.3.4 Quality Plan

Bidder should have POWERGRID approved and valid SMQP by the date of technical bid opening.

1.3.5 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.



SECTION-2

2.0 General Specification

- 2.1 Current transformers shall comply with IEC-61869-1 and 61869-2.
- 2.2 The instrument transformers shall be designed for use in geographic and meteorological conditions as given in Section-3.
- 2.3 The CT's used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.
- 2.4 One number single phase current transformer (outdoor) for earth fault protection shall be provided for each bank of reactor and shall be located in the neutral conductor connecting common neutral point with earth.
- 2.5 Secondary resistance and magnetising current characteristics of PX / PS class (protection) (as per IS or IEC) CT of same rating shall match. This is applicable for Neutral CT (outdoor) also and shall be reviewed during detail engineering.

2.6 Technical Parameters of Neutral Current Transformer (Outdoor type):

Common Neutral Side (for each three phase bank)

(a) Ratio	: 300/1 A
(b) Minimum knee point voltage	: 300 V
(c) Accuracy class	: PX / PS
(d) Maximum CT Resistance	: 1 Ohms
(e) Application	: Earth fault protection
(f) Maximum magnetization Current at $V_k/4$ (V_k = knee-point voltage)	: 40 mA

- 2.7 The secondary excitation current of class PX / PS shall not be more than 4 % of rated secondary current at 25% of knee point voltage.
- 2.8 For PX / PS class CT's, Dimensioning parameter "K", Secondary VA shall be considered 1.5 and 20 respectively.



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

- 2.9 Rated continuous thermal current rating shall be 200% of rated primary current.
- 2.10 The CT used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.
- 2.11 In case of single phase reactor, Common Neutral Side shall be out door type.
- 2.12 Construction Features

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

- a. Current transformers of **33kV** class, shall be oil filled/SF₆ gas filled, suitable for outdoor service and upright mounting on steel structures.
 - b. Bushings/Insulators shall conform to requirements stipulated in Section-3. 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. Oil filling and drain plugs are not required for SF₆ gas filled CT.
 - d. Current transformers shall be hermetically sealed units. The details of the arrangements made for the sealing of current transformers shall be furnish during detailed engineering.
 - e. Polarity marks shall indelibly be marked on each current transformer and at the lead terminals at the associated terminal block.
 - f. SF₆ gas filled CT shall be provided with a suitable SF₆ gas density monitoring device, with NO/NC contacts to facilitate the remote annunciation and tripping in case of SF₆ gas leakage. Provisions shall be made for online gas filling. Suitable rupture disc shall be provided to prevent explosion.
 - g. The instrument transformers shall be complete with its terminal box.
 - h. The external surface of instrument transformer, if made of steel, shall be hot dip galvanized or painted as per Section-3. External surface of aluminum can have natural finish.
 - i. The impregnation details along with tests/checks to ensure successful completion of impregnation cycle shall be furnished for approval.
- 2.13 Terminal box shall conform to the requirements of Section-3.
- 2.14 **Insulating Oil/Gas:**
- a. Insulating oil to be used for current transformers shall be of EHV grade and shall conform to IS-335/IEC-60296 (required for first filling).
 - b. The SF₆ gas shall comply with IEC-60376, 60376A, 60376B & **IEC-60480** and shall be suitable in all respects for use in the switchgear under operating conditions.
- 2.15 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 shall be clearly indicated



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

on the name plate.

- 2.16 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. These secondary terminals shall be terminated to stud type non disconnecting terminal blocks inside the terminal box.

In case of inverted type (Live Tank) current transformers, the manufacturer shall meet following additional requirements:

- (i) The primary conductor shall preferably be of bar type meeting the desired characteristics.
 - (ii) 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 i.e. insulation at neck 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) Bellows made of stainless steel shall be used at the top for hermetic sealing of CT.
 - (v) Bidder/Manufacturer shall recommend whether any special storage facility is required for spare CT.
- 2.17 Core lamination shall be of cold rolled grain oriented silicon steel or other equivalent alloys. μ metal or nano-crystalline core can also be used for metering cores.
- 2.18 The expansion chamber at the top of the porcelain insulators should be suitable for expansion of oil.
- 2.19 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 shall submit the details of packing and transportation design to the Employer for review.
- 2.20 The CT shall be designed so as to achieve the minimum risks of explosion in service. Bidder/Manufacturer shall bring out in his offer, the measures taken to achieve this.
- 2.21 Facilities shall be provided in the terminal box for short circuiting and grounding of CT secondary terminals.
- 2.22 Current transformers shall be provided with grounding connections.
- 2.23 Tests: Shall be as per IEC-61869-1 and 61869-2.



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii)765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

GENERAL TECHNICAL REQUIREMENTS-SECTION 3

Site Information

S.No.	Particular	Details
a)	Owner	Fatehgarh-II Transco Limited- a 100% wholly owned subsidiary of Power Grid Corporation of India Limited
b)	Customer	Fatehgarh-II Transco Limited- a 100% wholly owned subsidiary of Power Grid Corporation of India Limited
c)	Project Title	Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route
d)	Location	Fatehgarh-2, Rajasthan Bhadla-2, Rajasthan
e)	Transport Facilities	Road/Train Nearest Rail Head For Fatehgarh-2: Fatehgarh Nearest Rail Head For Bhadla-2: Nokha
SITE CONDITIONS		
a)	Max. ambient air temp.	50°C
b)	Min. ambient air temp.	0°C
c)	Max. design ambient temp.	50°C
d)	Design reference temp.	50°C
e)	Average Humidity	Max. 100%
f)	Special corrosion conditions	No
g)	Solar Radiation	1.2kW/sqmtr
h)	Atmospheric UV radiation	High
i)	Altitude above sea level	Less than 1000 meter above mean sea level (MSL)
j)	Pollution Severity	High Pollution level
k)	Seismic Zone	As per IS 1893 but not less than 0.3g horizontal
WIND DATA		
	Wind velocity	As per IS-875
	Average No. of thunderstorm days per annum	As per IS
Main Electrical Parameters:		
	Fault Levels:	765kV: 40kA for 1 sec
	Creepage Distance	25mm/kV for All Equipment i.e BPI/Bushings, CB, Isolator, CT, CVT, LA, WT, NCT etc. 31mm/kV for string insulators



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV
 Bhadla-2 (PG) S/s Extension under Transmission System
 Associated With LTA applications from Rajasthan SEZ
 Part-B (Rajasthan SEZ Part-B Project) through Tariff
 Based Competitive Bidding (TBCB) Route.
 33kV Current Transformer
 Doc. No. : TB-409-510-007 Rev 00**

GENERAL TECHNICAL REQUIREMENTS-SECTION 3 INDEX

Clause No.	Item
1.0	Foreword
2.0	General Requirement
3.0	Standards
4.0	Services to be performed by the Equipment being furnished
5.0	Engineering Data and Drawings
6.0	Material/Workmanship
7.0	Design Improvements/Coordination
8.0	Quality Assurance Programme
9.0	Type Testing & Clearance Certificates
10.0	Deleted.
11.0	Packaging & Protection
12.0	Finishing of Metal Surfaces
13.0	Deleted
14.0	Tools
15.0	Auxiliary Supply
16.0	Support Structure
17.0	Deleted
18.0	Control Cabinets, Junction Boxes, Terminal Boxes & Marshalling Boxes for Outdoor Equipment
19.0	Deleted
20.0	Terminal Blocks and Wiring
21.0	Lamps and Sockets
22.0	Bushings, Hollow Column Insulators, Support Insulators
23.0	Deleted
Annexure-A	Corona and Radio Interference Voltage (RIV) Test
Annexure-B	Seismic Withstand Test Procedure
Annexure-C	List of General Standards and Codes
Annexure-G	MQP & Inspection Level Requirement



GENERAL TECHNICAL REQUIREMENTS-SECTION 3

1.0 FOREWORD

The provisions under this section are intended to supplement requirements for the materials, equipments and services covered under other sections of tender documents and are not exclusive.

The Supplier shall note that the standards mentioned herein are not mutually exclusive or complete in themselves, but are intended to complement each other, with minimum repetition, to define the requirements of the Specification. In the event of a conflict between requirements of any two clauses of the Specification/ documents or requirements of different codes/ standards specified, the more stringent requirement as per the interpretation of the owner shall apply, unless confirmed otherwise by the owner in writing based on a written request from the Supplier.

In case of conflicting requirements between this document (General Technical Requirement Section 3) and equipment specification (Section 1 & Section 2), equipment specification shall prevail.

When specific requirements stipulated in the Specification exceed or change those required by the applicable standards, the stipulations of the Specification shall take precedence.

Unless specifically agreed to by the Purchaser prior to Award of Contract, the Work shall be in accordance with the standards indicated and the requirements of the Specification. The Supplier shall be held responsible for any deviation.

In case of conflict between the various standards, the decision of owner shall be binding & final.

2.0 GENERAL REQUIREMENT

The following words and expressions shall have the meanings hereby assigned to them throughout this document

"Employer /Owner" means Power Grid Corporation of India Ltd.



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

"Purchaser" means Bharat Heavy Electricals Limited

"Supplier /Manufacturer /Bidder" means the person or persons, firm or company assigned to execute the works as defined by the scope of supply, described here.

"Specification" refers to this document.

The supplier should be approved by Power Grid. If not, it is the responsibility of the vendor to be assessed and approved by Power Grid, before placement of order by BHEL. Any cost involved in vendor assessment/ approval must be borne by the vendor himself.

- 2.1 The Supplier /Manufacturer shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification during detailed engineering.
- 2.2 It is recognised that the Bidder may have standardised on the use of certain components, materials, processes or procedures different from those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to Employer.
- 2.3 Wherever a material or article is specified or defined 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.
- 2.4 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 though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components which are minor in nature and incidental to the requirement but not specifically stated in the specification, which are necessary for commissioning and satisfactory operation of the switchyard/ substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment provided, shall be interchangeable with one another.
- 2.5 Deleted.



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

2.6 Deleted.

3.0 STANDARDS

- 3.1 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.
- 3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the originally scheduled date of bid opening) of standard specified under Annexure-C of this section, unless specifically mentioned in the specification.
- 3.3 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.
- 3.4 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.
- 3.5 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.
- 3.6 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards specified under Annexure-C/individual sections for various equipments shall also, be accepted, however the salient points of difference shall be clearly brought out during detailed engineering along with English language version of such standard. The equipment conforming to standards other than specified under Annexure-C/ individual sections for various equipments shall be subject to Employer's approval.

4.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

- 4.1 The 800kV system is being designed to limit the switching surge over voltage of 1.9 p.u. and the power frequency over voltage of 1.4 p.u. The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc under such over voltage conditions.
- 4.2 All equipments shall also perform satisfactorily under various other electrical,



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii)765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

electromechanical and meteorological conditions of the site of installation.

- 4.3 All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.
- 4.4 The bidder shall design terminal connectors of the equipment taking into account various forces that are required to withstand.
- 4.5 The equipment shall also comply to the following:
- a) To facilitate erection of equipment, all items to be assembled at site shall be “match marked”.
 - b) All piping, if any between equipment control cabinet/operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

4.6 System Parameter

765kV, 400kV & 220kV System

SL No	Description of parameters	765kV System
1.	System operating voltage	765kV
2.	Maximum operating voltage of the system (rms)	800kV
3.	Rated frequency	50HZ
4.	No. of phase	3
5.	Rated Insulation levels	
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	2100kVp
ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	1550kVp
iii)	One minute power frequency dry withstand voltage (rms)	830kV
SL No	Description of parameters	765kV System
iv)	One minute power frequency dry and wet withstand voltage (rms)	-
6.	Corona extinction	508 kV



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

	voltage	
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz	2500 μ V at 508 kV rms
8.	Minimum creepage distance - for Equipment other than Insulator string	20000 mm
	Minimum creepage distance - for Insulator String	24800 mm
9	Min. clearances	
i.	Phase to phase	7600mm (for conductor conductor configuration) 9400mm (for rod-conductor configuration)
ii.	Phase to earth	4900mm (for conductor structure) 6400mm (for rod- structure)
iii.	Sectional clearances	10300 mm
10.	Rated short circuit current for 1 sec. duration	40kA
11.	System neutral earthing	Effectively earthed

Notes:

1. The above parameters are applicable for installations up to an altitude of 1000m above mean sea level. For altitude exceeding 1000m, necessary altitude correction factor shall be applicable as per relevant IEC.
2. The insulation and RIV levels of the equipments shall be as per values given in the Technical Specification of respective equipment.
3. Corona and radio interference voltage test and seismic withstand test procedures for equipments shall be in line with the procedure given at **Annexure-A** and **Annexure-B** respectively.

5.0 ENGINEERING DATA AND DRAWINGS



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

5.1 Deleted.

5.2 The Bidder shall submit 4 (four) sets of drawings/ design documents /data / detailed bill of quantity and 1 (one) set of test reports for the approval of the Employer. The bidder shall also submit the softcopy of the above documents in addition to hardcopy.

5.3 Drawings

- 5.3.1 All drawings submitted by the Bidder shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.
- 5.3.2 Drawings submitted by the Bidder 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. POWERGRID has standardized a large number of drawings/ documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings along with type test reports) is required. However, distribution copies of standard drawings/ documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.
- 5.3.3 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 substation 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 Bidder, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.
- 5.5 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Bidder's risk. The Bidder 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 Bidder's drawing or work by the Employer shall not



relieve the bidder of any of his responsibilities and liabilities under the Contract.

- 5.6 All engineering data submitted by the Bidder 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 expressly requested by the Employer in Writing.

5.7 Approval Procedure

The following schedule shall be followed generally for approval and for providing final documentation.

i) Approval/comments/

As per schedule

by Employer on initial submission

ii) Resubmission

As per

contract

(whenever

required)

iii) Approval or comments

As per contract

iv) Furnishing of distribution

2 weeks from the date

copies (2 hard copies to each

of approval

substation and one scanned
copy (pdf format)

v) Furnishing of distribution

copies of test reports

(a) Type test reports

2 weeks from the

date

(one scanned softcopy in

of final approval

pdf format to each substation



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

plus one for corporate centre
& one hardcopy per substation)

(b) Routine Test Reports

-do-

(one copy for each
substation)

vi) Furnishing of instruction/

On completion of Engineering

operation manuals (2 copies
per substation and one softcopy
(pdf format) for corporate centre
& per substation)

(vii) As built drawings (two sets of

On completion of entire works

hardcopy per substation & one
softcopy (pdf format) for corporate centre & per substation)

NOTE :

(1) The bidder may please note that all resubmissions must incorporate all comments given in the earlier submission by the Employer or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

(2) All drawings should be submitted in softcopy form, however substation design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version. SLD, GA & layout drawings shall be submitted for the entire substation in case of substation extension also.

(3) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.

(4) If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Bidder to the Employer.



(5) The Bidder shall furnish to the Employer catalogues of spare parts.

(6) All As-built drawings/documents shall be certified by site indicating the changes before final submission.

6.0 MATERIAL / WORKMANSHIP

6.1 General Requirement

- 6.1.1 Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.
- 6.1.2 In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the Employer shall decide upon the question of similarity. When required by the specification or when required by the Employer the Bidder shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it is to be understood that the cost as well as the time delay associated with the rejection shall be borne by the Bidder.
- 6.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfil their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Employer.
- 6.1.4 Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

6.1.5 Deleted.

6.1.6 The Bidder shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Bidder shall apply all operational lubricants to the equipment installed by him.

6.1.7 All oil, grease and other consumables used in the Works/Equipment shall be purchased in India unless the Bidder has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case, he shall declare in the proposal, where such oil or grease is available. He shall help Employer in establishing equivalent Indian make and Indian Bidder. The same shall be applicable to other consumables too.

6.2 Provisions For Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

6.2.1 Space Heaters

6.2.1.1 The heaters shall be suitable for continuous operation at 240V as supply voltage. On-off switch and fuse shall be provided.

6.2.1.2 One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

6.2.2 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on 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 interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.



6.2.3 Ventilation opening

Wherever ventilation is provided, the compartments shall have ventilation openings with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust.

6.2.4 Degree of Protection

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall comply with following degree of protection as detailed here under:

- a) Installed out door: IP- 55
- b) Installed indoor in air conditioned area: IP-31
- c) Installed in covered area: IP-52
- d) Installed indoor in non-air conditioned area where possibility of entry of water is limited: IP-41.
- e) For LT Switchgear (AC & DC distribution Boards): IP-52

The degree of protection shall be in accordance with IS:13947 (Part-I)/IEC-60947 (Part-I)/IS 12063/IEC-60529. Type test report for IP-55 or higher degree of protection test, shall be submitted for approval.

6.3 RATING PLATES, NAME PLATES AND LABELS

- 6.3.1 Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Employer. The rating plate of each equipment shall be according to IEC requirement.
- 6.3.2 All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

6.4 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into operation, shall be furnished by the Bidder unless specifically excluded under the exclusions in these specifications and documents.

7.0 DESIGN IMPROVEMENTS / COORDINATION

- 7.1 Deleted.
- 7.2 Deleted.
- 7.3 The Bidder shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.
- 7.4 The Bidder has to coordinate designs and terminations with the agencies (if any) who are Consultants/Bidder for the Employer. The names of agencies shall be intimated to the successful bidders.
- 7.5 The Bidder will be called upon to attend design co-ordination meetings with the Engineer, other Bidder's and the Consultants of the Employer (if any) during the period of Contract. The Bidder shall attend such meetings at his own cost at POWERGRID Corporate Centre, Gurgaon (Haryana) or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

8.0 QUALITY ASSURANCE PROGRAMME

- 8.1 To ensure that the equipment and services under the scope of this Contract, whether manufactured or performed within the Bidder's Works or at his Sub-Bidder's premises or at the Employer's site or at any other place of Work as applicable, are in accordance with the specifications, the Bidder shall ensure suitable quality assurance programme to control such activities at all points necessary. A quality assurance programme of the Bidder shall be in line with ISO requirements & shall generally cover the following:



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

- a) The 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-Bidder'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, 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 feedback 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, 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



transmission line/substation equipments as applicable, Civil/erection Works which is required to be followed for associated works.

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 Bidder /his vendor's quality management and control activities.

8.2 Quality Assurance Documents

The Bidder shall ensure availability of 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, welding operator's qualification procedure and welding identification symbols.
- iv) Raw Material test reports on components as specified by the specification and in the quality plan.
- v) The Manufacturing Quality Plan (MQP) indicating Customer Inspection Points (CIPs) at various stages of manufacturing and methods used to verify that the inspection and testing points in the quality plan were performed satisfactorily.
- vi) Factory test results for testing required as per applicable quality plan/technical specifications/GTP/Drawings etc.
- vii) Stress relief time temperature charts/oil impregnation time temperature charts, wherever applicable.

8.3 INSPECTION, TESTING & INSPECTION CERTIFICATE

- 8.3.1 Bidder shall procure bought out items from sub-vendors as per the list in "Compendium of Vendors" available on POWERGRID web-site www.powergridindia.com after ensuring compliance to the requirements/conditions mentioned therein. Bidder shall explore first the possibilities of procuring the bought out items from POWERGRID approved existing vendors. In case of their unavailability / non-response, Bidder may approach POWERGRID for additional sub-vendor approval. In that case, the assessment



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

report of proposed sub vendor by Bidder along with the enclosures as per Annexure-F shall be submitted within 60 days of the award. The proposal shall be reviewed and approval will be accorded based on the verification of the document submitted and/or after the physical assessment of the works as the case may be. The physical assessment conducted by POWERGRID, if required, shall be on chargeable basis. Charges shall be as per the POWERGRID norms prevailing at that time, which shall be intimated by POWERGRID separately. If proposal for sub-vendor is submitted after 60 days, the Bidder's proposal normally will not be considered for current LOA. However, POWERGRID may process the case for developing more vendors for referred items, if found relevant. In all cases, It is the responsibility of the Bidder that Project activities do not suffer on account of delay in approval/non approval of a new sub-vendor.

The responsibility and the basis of inspection for various items & equipment is placed at Annexure-G along with the requirement of MQP (Manufacturing Quality Plan), ITP (Inspection & Test Plan), FAT (Factory Acceptance Test) which should be valid & POWERGRID approved and Level of inspection envisaged against each item.

Bidder shall ensure that order for items where MQP/ITP/FAT is required will be placed only on vendors having valid MQP/ITP/FAT and where the supplier's MQP/ITP/FAT is either not valid or has not been approved by POWERGRID, MQP shall be generally submitted as per POWERGRID format before placing order.

Items not covered under MQP/ITP/FAT shall be offered for inspection as per POWERGRID LOA/technical Specifications/POWERGRID approved data sheets/POWERGRID approved drawings and relevant Indian/International standards. Inspection Levels: For implementation of projects in a time bound manner and to avoid any delay in deputation of POWERGRID or its authorized representative, involvement of POWERGRID for inspection of various items / equipment will be based on the level below:

Level –I: Bidder to raise all inspection calls and review the report of tests carried out by the manufacturer, on his own, as per applicable standards/ POWERGRID specification, and submit to concerned POWERGRID inspection office/ Inspection Engineer. CIP/MICC will be issued by POWERGRID based on review of test reports/certificates of manufacturers.

Level – II: Bidder to raise all inspection calls and carry out the inspection on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during inspection, the same would be intimated to Bidder and CIP/MICC will be issued by POWERGRID. Else, Bidder would submit their test reports/certificates to POWERGRID.



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

CIP/MICC will be issued by POWERGRID based on review of test reports/certificates.

Level - III: Bidder to raise inspection calls for both, stage (as applicable) & final inspection and carry out the stage inspections (if applicable) on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during stage inspection, the same would be intimated to Bidder and CIP will be issued by POWERGRID. Else, Bidder would submit the test reports / certificates of stage inspection after their own review and CIP will be issued by POWERGRID based on review of test reports / certificates. Final inspection will be carried out by POWERGRID and CIP/MICC will be issued by POWERGRID.

Level – IV: Bidder to raise inspection calls for both, stage (as applicable) & final inspections. POWERGRID will carry out the inspection for both stage & final inspection as per applicable standards/specification and CIP/MICC will be issued by POWERGRID.

- 8.3.2 Bidder shall ensure that to implement the above inspection levels, particularly for the quality control and inspection at sub-vendor's works, they would depute sufficient qualified & experienced manpower in their Quality Control and Inspection department. Further, to assure quality of construction, Bidder shall have a separate workforce having appropriate qualification & experience and deploy suitable tools and plant for maintaining quality requirement during construction in line with applicable Field Quality Plan (FQP).
- 8.3.3 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 Bidder's premises or Works and shall have the power at all reasonable times to ensure that proper Quality Management practices / norms are adhered to, inspect and examine the materials & workmanship of the Works, to carry out Quality/Surveillance Audit during manufacture or erection and if part of the Works is being manufactured or assembled at other premises or works. The Bidder shall obtain for the Employer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works. The item/equipment, if found unsatisfactory with respect to workmanship or material is liable to be rejected. The observations for improvements during product/ process inspection by POWERGRID shall be recorded in Quality Improvement Register (available & maintained at works) for review & timely compliance of observations.
- 8.3.4 Bidder shall submit inspection calls over internet through POWERGRID website. The required vendor code and password to enable raising inspection call will be furnished to the main Bidder within 30 days of award of contract on submission of documents by



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

Bidder. After raising the inspection calls, Bidder shall then proceed as per the message of that particular call which is available on the message board.

- 8.3.5 The Employer reserves the right to witness any or all type, acceptance and routine tests specified for which the Bidder shall give the Employer / Inspector Twenty one (21) days written notice of any material being ready for testing for each stage of testing as identified in the approved quality plan as customer inspection point(CIP) for indigenous inspections. All inspection calls for overseas material shall be given at least forty five (45) days in advance. Such tests shall be to the Bidder's account except for the expenses of the Inspection Engineer. The Employer / inspector, unless witnessing of the tests is waived by Employer, 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 Bidder 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 three copies of tests, duly certified. Bidder 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. CIP/Material Inspection clearance certificate (MICC) shall be issued by the Employer after inspection of the equipment or review of test reports as applicable. 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. CIP/MICC will be issued only after review and approval of the test reports.
- 8.3.6 Bidder shall generally offer material for inspection as per supply bar chart approved by POWERGRID and not before 30 days from schedule indicated in the bar chart. In case Bidder offers material(s) for inspection prior to 30 days from the scheduled date with necessary approval of POWERGRID, POWERGRID shall inspect the material and issue CIP only. However, in such an exceptional case, MICC shall be issued only as per provision of original / revised approved supply schedule.
- 8.3.7 Bidder shall minimize the number of inspection calls by offering optimum quantities in each inspection call at the respective manufacturer's works.
- 8.3.8 Bidder shall inspect the material themselves and only after they are fully convinced about the Quality, they shall offer the material for POWERGRID inspection and shall also ensure that relevant portion of LOA/NOA, approved drawing and data sheets along with applicable Quality Plans are available at the works of Bidder or their Sub-vendor before the material is offered for inspection.
- 8.3.9 Bidder shall ensure that material which has been cleared for dispatch after inspection



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

will be dispatched within 30 days in case of domestic supplies and within 60 days in case of Off-shore supplies from the date of issuance of CIP. Material which is not dispatched within stipulated time as above will be reoffered for POWERGRID inspection or specific approval of POWERGRID QA&I shall be obtained for delayed dispatch.

- 8.3.10 The Employer or IE shall give notice in writing to the Bidder, of any objection either to conformance to any drawings or to any equipment and workmanship which in his opinion is not in accordance with the Contract. The Bidder 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 / Inspection Engineer giving reasons therein, that no modifications are necessary to comply with the Contract.
- 8.3.11 All Test Reports and documents to be submitted in English during final inspection of equipment by POWERGRID or as and when required for submission.
- 8.3.12 When the factory tests have been completed at the Bidder's or Sub-Bidder's works, the Employer / Inspection Engineer (IE) shall issue a certificate to this effect within fifteen (15) days after completion of tests & submission of documents by Bidder / manufacturer but if the tests are not witnessed by the Employer / IE, the certificate shall be issued within fifteen (15) days of receipt of the Bidder's Test certificate by the Employer / IE. Bidder shall, on completion of all tests, submit test reports within Ten (10) days to POWERGRID IE. Failure of the Employer / IE to issue such a certificate shall not prevent the Bidder 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.
- 8.3.13 In all cases, where the Contract provides for tests whether at the premises or works of the Bidder or of any Sub- Bidder, the Bidder, 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 / Inspection Engineer or to his authorised representative to accomplish testing.
- 8.3.14 The inspection and acceptance by Employer and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Bidder 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.



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

- 8.3.15 The Employer will have the right of having at his own expenses any other test(s) of reasonable nature carried out at Bidder'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.
- 8.3.16 The Employer reserves the right for getting any additional field tests conducted on the completely assembled equipment at site to satisfy that material complies with specifications.
- 8.3.17 Rework/ Re-engineering, if any, on any item/equipment shall be carried out only after mutual discussions and in accordance with mutually agreed procedure. Bidder shall submit Joint Inspection Report of equipments under Re-Work/ Re-Engineering alongwith procedure for the same to POWERGRID for approval, before taking up the Re-Work/ Re-Engineering, failing which POWERGRID reserves the right to reject the equipment.
- 8.3.18 Bidder may establish a field test Laboratory to execute Civil Construction testing requirements at site with the condition that all testing equipment shall be calibrated from POWERGRID approved accredited Testing laboratories, with calibration certificates kept available at site and all testing personnel employed in the Field Testing Laboratories to be qualified and experienced Engineers or testing to be carried out at POWERGRID approved Third Party Laboratories.
- 8.3.19 Bidder shall ensure that all possible steps are taken to avoid damages to the equipment during transport, storage and erection.
- 8.3.20 Bidder shall implement additional stringent quality checks and preparation during installation of GIS at site (if applicable) as per POWERGRID approved guidelines/ Technical specifications.
- 8.3.21 Bidder shall ensure commissioning of all CSDs along with Circuit Breakers wherever applicable.
- 8.3.22 For EHV transformers/reactors:

Insulation oil shall be as per POWERGRID Technical specifications and same grade shall be used for impregnation of the active part & testing at the works of Transformer/Reactor Manufacturer and as well as for filling the Transformer/Reactors at site. Bidder to ensure that windings for Transformer/Reactors are made in air conditioned environment. Core-coil assembly shall be performed in positive



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

pressurized dust controlled environment. Dust measurements shall be monitored regularly at Transformer / Reactor Manufacturer works. Bidder shall ensure that respective civil foundations & Fire walls for Transformer / Reactors units to be commissioned, shall be made ready at concerned sites before receipt of Transformer / Reactors units. All the requisite material for Neutral & Delta Bus formation required for charging of complete bank of 765KV class 1-ph Transformer / Reactor units shall be made available at the concerned sites before receipt of the Transformer / Reactor units at site.

- 8.3.23 The Employer reserves the right to increase or decrease their involvement in inspections at Bidder's Works or at his Sub-Bidder's premises or at the Employer's site or at any other place of Work based on performance of Bidder/sub-Bidder.

9.0 TYPE TESTING & CLEARANCE CERTIFICATE

- 9.1 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 respective sections.
- 9.2 The reports for all type tests as per technical specification shall be furnished by the Bidder alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all projects 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 POWERGRID or representative authorized by POWERGRID or Utility or representative of accredited test lab.

Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted on or after 05-Nov-2009. In case the test reports are of the test conducted earlier than 05-Nov-2009, the bidder shall repeat these test(s) at no extra cost to the BHEL/Employer.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes 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 BHEL/Employer.

The Bidder shall intimate the Employer the detailed program about the type tests



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

- 9.3 The Employer intends to repeat those type tests which are indicated in the price schedule and the same shall be payable as per provision of contract. The price of conducting 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. The Employer reserves the right to waive the repeating of type tests partly or fully and in case of waiver, test charges for the same shall not be payable.
- 9.4 The Employer reserves the right to witness any or all the type tests. The Employer shall bear all expenses for deputation of Employer's representative(s) for witnessing the type tests.
- 9.5 The list of makes of various items, for which Type test reports are not required to be submitted are specified in Compendium of Vendors (COV).

10.0 Deleted.

11.0 PACKAGING & PROTECTION

- 11.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Employer, the Bidder shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Employer to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Bidder. Employer takes no responsibility of the availability of the wagons.
- 11.2 All coated surfaces shall be protected against abrasion, impact, discolouration 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 and pipings and



conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

12.0 FINISHING OF METAL SURFACES

12.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS: 2629.

12.2 HOT DIP GALVANISING

- 12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq.m minimum.
- 12.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- 12.2.3 After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate or alternate approved treatment shall be provided to avoid formation of white rust after hot dip galvanization.
- 12.2.4 The galvanized steel shall be subjected to four numbers of one minute dips in copper sulphate solution as per IS-2633.
- 12.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.
- Coating thickness
 - Uniformity of zinc
 - Adhesion test



- Mass of zinc coating

- 12.2.6 Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of touch-up zinc rich paint at site shall be allowed with approval of Engineer Incharge.

12.3 PAINTING

- 12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
- 12.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.
- 12.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.
- 12.3.4 The exterior and interior colour of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Glossy white colour inside the equipments /boards /panels/junction boxes is also acceptable. The exterior colour for panels shall be matching with the existing panels in case of extension of a substation. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.
- 12.3.5 In case the bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted during detailed engineering for Employer's review & approval.



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

12.3.6 The colour scheme as given below shall be followed for Fire Protection and Air Conditioning systems

S.No.	PIPE LINE	Base colour	Band colour
Fire Protection System			
1	Hydrant and Emulsifier system pipeline	FIRE RED	-
2	Emulsifier system detection line – water	FIRE RED	Sea Green
3	Emulsifier system detection line –Air	FIRE RED	Sky Blue
4	Pylon support pipes	FIRE RED	-
Air Conditioning Plant			
5	Refrigerant gas pipeline – at compressor suction	Canary Yellow	-
6	Refrigerant gas pipeline – at compressor discharge	Canary Yellow	Red
7	Refrigerant liquid pipeline	Dark Admiralty Green	-
8	Chilled water pipeline	Sea Green	-
9	Condenser water pipeline	Sea Green	Dark Blue

The direction of flow shall be marked by → (arrow) in black colour.



Base Colour Direction of flow Band Colour

12.3.7 For aluminium casted surfaces, the surface shall be with smooth finish. Further, in case of aluminium enclosures, the surface shall be coated with powder (coating thickness of 60 microns) after surface preparation for painting. For stainless steel surfaces, no painting is envisaged.

13.0 Deleted

14.0 TOOLS

14.1 Deleted



14.2 SPECIAL TOOLS AND TACKLES

The bidder shall supply all special tools and tackles required for Operation and maintenance of equipment. The special tools and tackles shall only cover items which are specifically required for the equipment offered and are proprietary in nature. The list of special tools and tackles, if any, shall be finalized during detail engineering and the same shall be supplied without any additional cost implication to the Employer.

14.3 Deleted

15.0 AUXILIARY SUPPLY

- 15.1 The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation and PLCC system shall also conform the parameters as indicated in the following table:

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	-

Combined variation of voltage and frequency shall be limited to + 10%.

16.0 SUPPORT STRUCTURE

- 16.1 The equipment support structures shall be suitable for equipment connections at the first level i.e 14.0 meter, 8.0 meter, 5.9 meter and 4.6 meter from plinth level for 765kV, 400kV, 220kV and 132kV substations respectively. All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.
- 16.2 The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 metres.



17.0 Deleted

18.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

- 18.1 All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS-5039/IS-8623, IEC-60439, as applicable, and the clauses given below:
- 18.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes shall be made of stainless steel of atleast 1.5 mm thick or aluminum enclosure of atleast 1.6 mm thick and shall be dust, water and vermin proof. Stainless steel used shall be of grade SS304 or better. 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 aluminium enclosed box the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.
- 18.3 A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes / Control cabinets to prevent ingress of rain water.
- 18.4 Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere.
- 18.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene/PU gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

Further, the gasketing arrangement shall be such that gaskets are pasted in slots (in door fabrication/gasket itself) in order to prevent ingress of dust and moisture inside the panels so that no internal rusting occurs in panels during the operation of the equipment.

- 18.6 All boxes/cabinets shall be designed for the entry of cables by means of weather proof and dust-proof connections. Boxes and cabinets shall be 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. Suitable cable gland plate above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof,



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV
Bhadla-2 (PG) S/s Extension under Transmission System
Associated With LTA applications from Rajasthan SEZ
Part-B (Rajasthan SEZ Part-B Project) through Tariff
Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

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

18.8 LED based illumination of minimum 9 watts shall be provided. The switching of the fittings shall be controlled by the door switch.

For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

18.9 All control switches shall be of MCB/rotary switch type and Toggle/piano switches shall not be accepted.

18.10 Earthing of the cabinet 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 self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

18.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/feruling by pasting the same on the inside of the door.

18.12 The following routine tests alongwith the routine tests as per IS:5039 shall also be conducted:

- i) Check for wiring
- ii) Visual and dimension check

18.13 The enclosure of bay marshalling kiosk, junction box, terminal box and control cabinets shall conform to IP-55 as per IS:13947 including application of 2KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test.

19.0 DELETED

20.0 TERMINAL BLOCKS AND WIRING

20.1 Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

- 20.2 Terminal blocks shall be 650V grade and have continuous rating to carry the maximum expected current on the terminals and non-breakable type. These shall be of moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But the terminal blocks shall be non-disconnecting stud type except for the secondary junction boxes of Current Transformer and Voltage Transformer.
- 20.3 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.
- 20.4 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.
- 20.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.
- 20.6 The terminal blocks shall be of extensible design, multilayer terminal arrangement is not allowed in any junction box (Common MB, Individual MB, JB etc.). There should be sufficient space at both sides of terminals so that ferrule number of wires / TB numbers are clearly visible during wire removal or insertion.
- 20.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 20.8 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.
- 20.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.
- a) All circuits except Minimum of two of 2.5 sq mm CT/PT circuits copper flexible.
 - b) All CT/PT circuits Minimum of 4 nos. of 2.5 sq mm copper flexible.
- 20.10 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 is live.



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

- 20.11 Atleast 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.
- 20.12 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate for outdoor ground mounted marshalling box and the clearance between two rows of terminal blocks shall be a minimum of 150 mm.
- 20.13 The Bidder shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets. For equipments rated for 400 kV and above the wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge over-voltages either transferred through the equipment or due to transients induced from the EHV circuits.
- 20.14 All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Bidder shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

21.0 LAMPS & SOCKETS

21.1 Lamps & Sockets

All lamps shall use a socket base as per IS-1258, except in the case of signal lamps. All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

21.2 Hand Lamp:

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

21.3 Switches and Fuses:

- 21.3.1 Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker / switch fuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.



- 21.3.2 All fuses shall be of HRC cartridge type conforming to IS: 9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

22.0 Bushings, Hollow Column Insulators, Support Insulators:

- 22.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable. The bidder may also offer composite hollow insulators, conforming to IEC-61462.
- 22.2 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.
- 22.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.
- 22.4 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.
- 22.5 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.
- 22.6 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.
- 22.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

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.

22.8 Tests

In bushing, 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 & IS:5621.

22.9 Deleted

23.0 Deleted

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 and 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 carried out in accordance with relevant IEC of respective equipment or NEMA standard Publication No. 107-1964.

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 noise 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

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

ANNEXURE-A

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 Employer'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 Employer'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.

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 Employer. 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 Employer.

The frequency range for the earthquake spectra shall be as per IEC-6227-300.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C****LIST OF GENERAL STANDARDS AND CODES**

CODES	TITLE
--	India Electricity Rules
--	Indian Electricity Act
--	Indian Electricity (Supply) Act
--	Indian Factories Act
IS-5	Colors for Ready Mixed Paints and Enamels
IS-335	New Insulating Oils
IS-617	Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes
IS-1448 (P1 to P 145)	Methods of Test for Petroleum and its Products
IS-2071 (P1 to P3)	Methods of High Voltage Testing
IS-12063	Classification of degrees of protection provided by enclosures of electrical equipment
IS-2165 ; P1:1997, P2:1983	Insulation Coordination
IS-3043	Code of Practice for Earthing
IS-6103	Method of Test for Specific Resistance (Resistivity) of Electrical Insulating Liquids
IS-6104	Method of Test for Interfacial Tension of Oil against Water by the Ring Method
IS-6262	Method of test for Power factor & Dielectric Constant of Electrical Insulating Liquids
IS-6792	Method for determination of electric strength of insulating oils
IS-5578	Guide for marking of insulated conductors
IS-11353	Guide for uniform system of marking & identification of conductors & apparatus terminals.
IS-8263	Methods for Radio Interference Test on High voltage Insulators
IS-9224 (Part 1,2&4)	Low Voltage Fuses
IEC-60060 (Part 1 to P4)	High Voltage Test Techniques
IEC 60068	Environmental Test
IEC-60117	Graphical Symbols
IEC-60156	Method for the Determination of the Electrical Strength of Insulation Oils
IEC-60270	Partial Discharge Measurements
IEC-60376	Specification and Acceptance of New Sulphur Hexafluoride
IEC-60437	Radio Interference Test on High Voltage Insulators
IEC-60507	Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems
IEC-62271-1	Common Specification for High Voltage Switchgear & Control gear Standards
IEC-60815	Guide for the Selection of Insulators in respect of Polluted Conditions

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
IEC-60865 (P1 & P2)	Short Circuit Current - Calculation of effects
ANSI-C.1/NFPA.70	National Electrical Code
ANSI-C37.90A	Guide for Surge Withstand Capability (SWC) Tests
ANSI-C63.21, C63.3	Specification for Electromagnetic Noise and Field Strength Instrumentation 10 KHz to 1 GHZ
C36.4ANSI-C68.1	Techniquet for Dielectric Tests
ANSI-C76.1/EEE21	Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings
ANSI-SI-4	Specification for Sound Level Meters
ANSI-Y32-2/C337.2	Drawing Symbols
ANSI-Z55.11	Gray Finishes for Industrial Apparatus and Equipment No. 61 Light Gray
NEMA-107T	Methods of Measurements of RIV of High Voltage Apparatus
NEMA-ICS-II	General Standards for Industrial Control and Systems Part ICSI-109
CISPR-1	Specification for CISPR Radio Interference Measuring Apparatus for the frequency range 0.15 MHz to 30 MHz
CSA-Z299.1-1978h	Quality Assurance Program Requirements
CSA-Z299.2-1979h	Quality Control Program Requirements
CSA-Z299.3-1979h	Quality Verification Program Requirements
CSA-Z299.4-1979h	Inspection Program Requirements
TRANSFORMERS AND REACTORS	
IS:10028 (Part 2 & 3)	Code of practice for selection, installation & maintenance of Transformers (P1:1993), (P2:1991), (P3:1991)
IS-2026 (P1 to P4)	Power Transformers
IS-3347 (part 1 to Part 8)	Dimensions for Porcelain transformer Bushings for use in lightly polluted atmospheres
IS-3639	Fittings and Accessories for Power Transformers
IS-6600	Guide for Loading of oil immersed Transformers
IEC-60076 (Part 1 to 5)	Power Transformers
IEC-60214	On-Load Tap-Changers
IEC-60289	Reactors
IEC- 60354	Loading Guide for Oil - Immersed power transformers
IEC-60076-10	Determination of Transformer and Reactor Sound Levels
ANSI-C571280	General requirements for Distribution, Power and Regulating Transformers
ANSI-C571290	Test Code for Distribution, Power and Regulation Transformers
ANSI-C5716	Terminology & Test Code for Current Limiting Reactors
ANSI-C5721	Requirements, Terminology and Test Code for Shunt Reactors Rated Over 500 KVA
ANSI-C5792	Guide for Loading Oil-Immersed Power Transformers upto and including 100 MVA with 55 deg C or 65 deg C Winding Rise

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
IS-3347 Part I to 8	Dimension for porcelain transformer bushing
DIN-42530	Bushing up to 1000kV from 250A-5000A for liquid filled Transformer
IS-2026 Part 1 to 5	Power transformer
IS-4691	Degrees of protection provided by enclosure for rotating electrical machinery
IEC-60034-5	Degrees of protection provided by integral design of rotating electrical machines(IP Code) classification
IS:325 / IEC -60034	Performance of cooling fan / oil pump motor
IS-13947 part 1 to 5	Specification for low voltage switchgear and control gear
IS:3400	Methods of test for vulcanised rubber
IS:7016 part 1 to 14	Methods of test for coated and treated fabrics
IS:803	Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tanks.
IS:3637	Gas operated Relays
IS:335	New Insulating oils – Specification
IEC-62271-203	Gas insulated metal enclosed switchgear for rated voltage above 52kV
IEC-61639	Direct connection between power transformers and gas-insulated metal enclosed switchgear for rated voltages of 52.5 kV and above.
IS:3400 / BS 903 / IS:7016	Air cell (Flexible Air Separator)
IEC 60529 / IP : 55	Degree of protection for cooler control cabinet , MOLG, Cooling fan , oil pump, Buchholz Relay
IEC 60529 / IP : 56	Degree of protection for Pressure Relief Device
IEC 60529 / IP : 43	Degree of protection for Remote tap Changer cubicle (RTCC)
CIRCUIT BREAKERS	
IEC-62271-100	High-voltage switchgear and control gear - Part 100: Alternating current circuit-breakers
IEC-62271-101	High-voltage switchgear and control gear - Part 101: Synthetic testing
IEC-62155	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V
IEC-62271-110	High-voltage switchgear and control gear - Part 110: Inductive load switching
IEC-62271-109	High-voltage switchgear and control gear - Part 110: Inductive load switching
CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS AND COUPLING CAPACITOR VOLTAGE TRANSFORMERS	
IS-2705- (P1 to P4)	Current Transformers

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
IS:3156- (P1 to P4)	Voltage Transformers
IS-4379	Identification of the Contents of Industrial Gas Cylinders
IEC-61869 (Part-1)	Instrument transformers - Part 1: General requirements
IEC-61869 (Part-2)	Instrument transformers - Part 2: Additional requirements for current transformers
IEC-61869 (Part-3)	Instrument transformers - Part 3: Additional requirements for inductive voltage transformers
IEC-61869 (Part-4)	Instrument transformers - Part 4: Additional requirements for combined transformers
IEC-61869 (Part-5)	Instrument transformers - Part 5: Additional requirements for capacitor voltage transformers
IEC-61869 (Part-6)	Instrument transformers - Part 6: Additional general requirements for low-power instrument transformers
IEC-61869 (Part-9)	Instrument transformers - Part 9: Digital interface for instrument transformers
IEC-61869 (Part-102)	Instrument transformers - Part 102: Ferroresonance oscillations in substations with inductive voltage transformers
IEC-61869 (Part-103)	Instrument transformers - The use of instrument transformers for power quality measurement
BUSHING	
IS-2099	Bushings for Alternating Voltages above 1000V
IEC-60137	Insulated Bushings for Alternating Voltages above 1000V
SURGE ARRESTERS	
IS-3070 (PART2)	Lightning arresters for alternating current systems : Metal oxide lightning arrestors without gaps
IEC-60099-4	Metal oxide surge arrestors without gaps
IEC-60099-5	Selection and application recommendation
ANSI-C62.1	IEE Standards for S A for AC Power Circuits
NEMA-LA 1	Surge Arresters
CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS	
IS-722, IS-1248	Electrical relays for power system
IS-3231, 3231 (P-3)	Protection
IS:5039	Distributed pillars for Voltages not Exceeding 1000 Volts
IEC-60068.2.2	Basic environmental testing procedures Part 2: Test B: Dry heat
IEC-60529	Degree of Protection provided by enclosures
IEC-60947-4-1	Low voltage switchgear and control gear
IEC-61095	Electromechanical Contactors for household and similar purposes
IEC-60439 (P1 & 2)	Low Voltage Switchgear and control gear assemblies
ANSI-C37.20	Switchgear Assemblies, including metal enclosed bus
ANSI-C37.50	Test Procedures for Low Voltage Alternating Current Power

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
	Circuit Breakers
ANSI-C39	Electric Measuring instrument
ANSI-C83	Components for Electric Equipment
IS: 8623: (Part I to 3)	Specification for Switchgear & Control Assemblies
NEMA-AB	Moulded Case Circuit and Systems
NEMA-CS	Industrial Controls and Systems
NEMA-PB-1	Panel Boards
NEMA-SG-5	Low voltage Power Circuit breakers
NEMA-SG-3	Power Switchgear Assemblies
NEMA-SG-6	Power switching Equipment
NEMA-5E-3	Motor Control Centers
1248 (P1 to P9)	Direct acting indicating analogue electrical measuring instruments & their accessories
Disconnecting switches	
IEC-62271-102	High-voltage switchgear and control gear - Part 102: Alternating current disconnectors and earthing switches
IEC-60265 (Part 1 & 2)	High Voltage switches
ANSI-C37.32	Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories
ANSI-C37.34	Test Code for high voltage air switches
NEMA-SG6	Power switching equipment
PLCC and line traps	
IS-8792	Line traps for AC power system
IS-8793	Methods of tests for line traps
IS-8997	Coupling devices for PLC systems
IS-8998	Methods of test for coupling devices for PLC systems
IEC-60353	Line traps for A.C. power systems
IEC-60481	Coupling Devices for power line carrier systems
IEC-60495	Single sideboard power line carrier terminals
IEC-60683	Planning of (single Side-Band) power line carrier systems
CIGRE	Teleprotection report by Committee 34 & 35
CIGRE	Guide on power line carrier 1979
CCIR	International Radio Consultative Committee
CCITT	International Telegraph & Telephone Consultative Committee
EIA	Electric Industries Association
Protection and control equipment	
IEC-60051: (P1 to P9)	Recommendations for Direct Acting indicating analogue electrical measuring instruments and their accessories
IEC-60255 (Part 1 to 23)	Electrical relays
IEC-60297 (P1 to P4)	Dimensions of mechanical structures of the 482.6mm (19 inches)

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
	series
IEC-60359	Expression of the performance of electrical & electronic measuring equipment
IEC-60387	Symbols for Alternating-Current Electricity meters
IEC-60447	Man machine interface (MMI) - Actuating principles
IEC-60521	Class 0.5, 1 and 2 alternating current watt hour metres
IEC-60547	Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM Standard (for electronic nuclear instruments)
ANSI-81	Screw threads
ANSI-B18	Bolts and Nuts
ANSI-C37.1	Relays, Station Controls etc
ANSI-C37.2	Manual and automatic station control, supervisory and associated telemetering equipment
ANSI-C37.2	Relays and relay systems associated with electric power apparatus
ANSI-C39.1	Requirements for electrical analog indicating instruments
MOTORS	
IS-325	Three phase induction motors
IS-4691	Degree of protection provided by enclosure for rotating electrical machinery
IEC-60034 (P1 to P19:)	Rotating electrical machines
IEC-Document 2	Three phase induction motors
(Central Office) NEMA-MGI	Motors and Generators
Electronic equipment and components	
MIL-21B, MIL-833 & MIL-2750	Environmental testing
EC-60068 (P1 to P5)	Printed boards
IEC-60326 (P1 to P2)	Material and workmanship standards
IS-1363 (P1 to P3)	Hexagon head bolts, screws and nuts of product grade C
IS-1364 (P1 to P5)	Hexagon head bolts, screws and nuts of products grades A and B
IS-3138	Hexagonal Bolts and Nuts (M42 to M150)
ISO-898	Fasteners: Bolts, screws and studs
ASTM	Specification and tests for materials
Clamps & connectors	
IS-5561	Electric power connectors
NEMA-CC1	Electric Power connectors for sub station
NEMA-CC 3	Connectors for Use between aluminium or aluminum-Copper Overhead Conductors
Bus hardware and insulators	
IS: 2121	Fittings for Aluminum and steel cored Al conductors for overhead

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
	power lines
IS-731	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V
IS-2486 (P1 to P4)	Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V
IEC-60120	Dimensions of Ball and Socket Couplings of string insulator units
IEC-60137	Insulated bushings for alternating voltages above 1000 V
IEC-60168	Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V
IEC-62155	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V
IEC-60273	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V
IEC-61462	Pressurized and un-pressurized insulator for use in electrical equipment with rated voltage greater than 1000V – Definitions, Test methods, acceptance criteria and design recommendations
IEC-60305	Insulators for overhead lines with nominal voltage above 1000V-ceramic or glass insulator units for ac systems Characteristics of String Insulator Units of the cap and pin type
IEC-60372 (1984)	Locking devices for ball and socket couplings of string insulator units : dimensions and tests
IEC-60383 (P1 and P2)	Insulators for overhead lines with a nominal voltage above 1000 V
IEC-60433	Characteristics of string insulator units of the long rod type
IEC-60471	Dimensions of Clevis and tongue couplings of string insulator units
ANSI-C29	Wet process porcelain insulators
ANSI-C29.1	Test methods for electrical power insulators
ANSI-C92.2	For insulators, wet-process porcelain and toughened glass suspension type
ANSI-C29.8	For wet-process porcelain insulators apparatus, post-type
ANSI-G.8	Iron and steel hardware
CISPR-7B	Recommendations of the CISPR, tolerances of form and of Position, Part 1
ASTM A-153	Zinc Coating (Hot-Dip) on iron and steel hardware
Strain and rigid bus-conductor	
IS-2678	Dimensions & tolerances for Wrought Aluminum and Aluminum Alloys drawn round tube
IS-5082	Wrought Aluminum and Aluminum Alloy Bars. Rods, Tubes and Sections for Electrical purposes
ASTM-B 230-82	Aluminum 1350 H19 Wire for electrical purposes

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
IS:1248	Indicating Instruments
IS:2208	HRC Fuses
IS:13947 (Part-3)	Air break switches, air break disconnectors & fuse combination units for voltage not exceeding 1000V AC or 1200V DC
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:6005	Code of practice for phosphating of Iron and Steel
IS:3231	Electrical relays for power system protection
IS:3842	Electrical relay for AC Systems
IS:5	Colours for ready mix paint
IEEE-484	Recommended Design for installation design and installation of large lead storage batteries for generating stations and substations
IEEE-485	Sizing large lead storage batteries for generating stations and substations
Wires and cables	
ASTMD-2863	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)
IS-694	PVC insulated cables for working voltages upto and including 1100 Volts
IS-1255	Code of practice for installation and maintenance of power cables, upto and including 33 kV rating
IS-1554 (P1 and P2)	PVC insulated (heavy duty) electric cables (part 1) for working voltage upto and including 1100 V Part (2) for working voltage from 3.3 kV upto and including 11kV
IS:1753	Aluminium conductor for insulated cables
IS:2982	Copper Conductor in insulated cables
IS-3961 (P1 to P5)	Recommended current ratings for cables
IS-3975	Mild steel wires, formed wires and tapes for armouring of cables
IS-5831	PVC insulating and sheath of electric cables
IS-6380	Elastometric insulating and sheath of electric cables
IS-7098	Cross linked polyethylene insulated PVC sheathed cables for working voltage upto and including 1100 volts
IS-7098	Cross-linked polyethyle insulated PVC sheathed cables for working voltage from 3.3kV upto and including 33 kV
IS-8130	Conductors for insulated electrical cables and flexible cords
IS-1753	Aluminum Conductors for insulated cables
IS-10418	Specification for drums for electric cables
IEC-60096 (part 0 to p4)	Radio Frequency cables
IEC-60183	Guide to the Selection of High Voltage Cables
IEC-60189 (P1 to P7)	Low frequency cables and wires with PVC insulation and PVC sheath

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
IEC-60227 (P1 to P7)	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V
IEC-60228	Conductors of insulated cables
IEC-60230	Impulse tests on cables and their accessories
IEC-60287 (P1 to P3)	Calculation of the continuous current rating of cables (100% load factor)
IEC-60304	Standard colours for insulation for low-frequency cables and wires
IEC-60331	Fire resisting characteristics of Electric cables
IEC-60332 (P1 to P3)	Tests on electric cables under fire conditions
IEC-60502	Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto to 30 kV
IEC-754 (P1 and P2)	Tests on gases evolved during combustion of electric cables
AIR conditioning and ventilation	
IS-659	Safety code for air conditioning
IS-660	Safety code for Mechanical Refrigeration
ARI:520	Standard for Positive Displacement Refrigeration Compressor and Condensing Units
IS:4503	Shell and tube type heat exchanger
ASHRAE-24	Method of testing for rating of liquid coolers
ANSI-B-31.5	Refrigeration Piping
IS:2062	Steel for general structural purposes
IS:655	Specification for Metal Air Dust
IS:277	Specification for Galvanised Steel Sheets
IS-737	Specification for Wrought Aluminium and Aluminium Sheet & Strip
IS-1079	Hot rolled cast steel sheet & strip
IS-3588	Specification for Electrical Axial Flow Fans
IS-2312	Propeller Type AC Ventilation Fans
BS-848	Methods of Performance Test for Fans
BS-6540 Part-I	Air Filters used in Air Conditioning and General Ventilation
BS-3928	Sodium Flame Test for Air Filters (Other than for Air Supply to I.C. Engines and Compressors)
US-PED-2098	Method of cold DOP & hot DOP test
MIL-STD-282	DOP smoke penetration method
ASHRAE-52	Air cleaning device used in general ventilation for removing particle matter
IS:3069	Glossary of Terms, Symbols and Units Relating to Thermal Insulation Materials
IS:4671	Expanded Polystyrene for Thermal Insulation Purposes
IS:8183	Bonded Mineral Wool
IS:3346	Evaluation of Thermal Conductivity properties by means of

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
	guarded hot plate method
ASTM-C-591-69	Standard specification for rigid preformed cellular urethane thermal insulation
IS:4894	Centrifugal Fans
BS:848	Method of Performance Test for Centrifugal Fans
IS:325	Induction motors, three-phase
IS:4722	Rotating electrical machines
IS:1231	Three phase foot mounted Induction motors, dimensions of
IS:2233	Designations of types of construction and mounting arrangements of rotating electrical machines
IS:2254	Vertical shaft motors for pumps, dimensions of
IS:7816	Guide for testing insulation resistance of rotating machines
IS:4029	Guide for testing three phase induction motors
IS: 4729	Rotating electrical machines, vibration of, Measurement and evaluation of
IS:4691	Degree of protection provided by enclosures for rotating electrical machinery
IS:7572	Guide for testing single-phase ac motors
IS:2148	Flame proof enclosure for electrical apparatus
BS:4999(Part-51)	Noise levels
Galvanizing	
IS-209	Zinc Ingot
IS-2629	Recommended Practice for Hot-Dip galvanizing on iron and steel
IS-2633	Methods for testing uniformity of coating of zinc coated articles
ASTM-A-123	Specification for zinc (Hot Galvanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips
ASTM-A-121-77	Zinc-coated (Galvanized) steel barbed wire
Painting	
IS-6005	Code of practice for phosphating of iron and steel
ANSI-Z551	Gray finishes for industrial apparatus and equipment
SSPEC	Steel structure painting council
Fire protection system	
--	Fire protection manual issued by tariff advisory committee (TAC) of India
HORIZONTAL CENTRIFUGAL PUMPS	
IS:1520	Horizontal centrifugal pumps for clear, cold and fresh water
IS:9137	Code for acceptance test for centrifugal & axial pumps
IS:5120	Technical requirement – Rotodynamic special purpose pumps
API-610	Centrifugal pumps for general services Hydraulic Institutes Standards

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
NFPA-13	Standard for the installation of sprinkler system
NFPA-15	Standard for water spray fixed system for the fire protection
NFPA-12A	Standard for Halong 1301 Fire Extinguishing System
NFPA-72E	Standard on Automatic Fire Detectors
--	Fire Protection Manual by TAC (Latest Edition)
NFPA-12	Standard on Carbon dioxide extinguisher systems
IS:3034	Fire of industrial building
--	Electrical generating and distributing stations code of practice
IS:2878	CO2 (Carbon dioxide) Type Extinguisher
IS:2171	DC (Dry Chemical Powder) type
IS:940	Pressurised Water Type
D.G. SET	
IS:10002	Specification for performance requirements for constant speed compression ignition (diesel engine) for general purposes
IS:10000	Method of tests for internal combustion engines
IS:4722	Rotating electrical machines-specification
IS:12063	Degree of protection provided by enclosures
IS:12065	Permissible limit of noise levels for rotating electrical machines
--	Indian Explosive Act 1932
Steel structures	
IS-228 (1992)	Method of Chemical Analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802 (P1 to 3)	Code of practice for use of structural steel in overhead transmission line towers
IS-806	Code of practice for use of steel tubes in general building construction
IS-808	Dimensions for hot rolled steel beam, column channel and angle sections
IS-814	Covered electrodes for manual arc welding of carbon of carbon manganese steel
IS-816	Code of Practice for use of metal arc welding for general construction in Mild steel
IS-817	Code of practice for training and testing of metal arc welders. Part 1 : Manual Metal arc welding
IS-875 (P1 to P4)	Code of practice for design loads (other than earthquake) for buildings and structures
IS-1161	Steel tubes for structural purposes
IS-1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates
IS-1363 (P1 to P3)	Hexagonal head bolts, screws & nuts of products grade C
IS-1364	Hexagon head bolts, screws and nuts of product grades A and B
IS-1367 (P1 to P18)	Technical supply condition for threaded steel fasteners

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
IS-1599	Methods for bend test
IS-1608	Method for tensile testing of steel products
IS-1893	Criteria for earthquake resistant design of structures
IS-1978	Line Pipe
IS-2062	Steel for general structural purposes
IS-2595	Code of practice for Radiographic testing
IS-3063	Single coil rectangular section spring washers for bolts, nuts and screws
IS-3664	Code of practice for ultrasonic pulse echo testing by contact and immersion methods
IS-7205	Safety code for erection of structural steel work
IS-9595	Recommendations for metal arc welding of carbon and carbon manganese steels
ANSI-B18.2.1	Inch series square and Hexagonal bolts and screws
ANSI-B18.2.2	Square and hexagonal nuts
ANSI-G8.14	Round head bolts
ASTM-A6	Specification for General Requirements for rolled steel plates, shapes, sheet piling and bars of structural use
ASTM-A36	Specifications of structural steel
ASTM-A47	Specification for malleable iron castings
ASTM-A143	Practice for safeguarding against embilement of Hot Galvanized structural steel products and procedure for detaching embrilement
ASTM-A242	Specification for high strength low alloy structural steel
ASTM-A283	Specification for low and intermediate tensile strength carbon steel plates of structural quality
ASTM-A394	Specification for Galvanized steel transmission tower bolts and nuts
ASTM-441	Specification for High strength low alloy structural manganese vanadium steel
ASTM-A572	Specification for High strength low alloy colombium-Vanadium steel of structural quality
AWS D1-0	Code for welding in building construction welding inspection
AWS D1-1	Structural welding code
AISC	American institute of steel construction
NEMA-CG1	Manufactured graphite electrodes
Piping and pressure vessels	
IS-1239 (Part 1 and 2)	Mild steel tubes, tubulars and other wrought steel fittings
IS -3589	Seamless Electrically welded steel pipes for water, gas and sewage
IS-6392	Steel pipe flanges
ASME	Boiler and pressure vessel code

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-C**

CODES	TITLE
	flameproof type)
IS:10322	Specification for flood light
IS:10322	Specification for decorative lighting outfits
IS:10322	Luminaries for street lighting
IS:2418	Tubular fluorescent lamps
IS:9900	High pressure mercury vapour lamps
IS:1258	Specification for Bayonet lamp fluorescent lamp
IS:3323	Bi-pin lamp holder tubular fluorescent lamps
IS:1534	Ballasts for use in fluorescent lighting fittings. (Part-I)
IS:1569	Capacitors for use in fluorescent lighting fittings
IS:2215	Starters for fluorescent lamps
IS:3324	Holders for starters for tubular fluorescent lamps
IS:418	GLS lamps
IS:3553	Water tight electric fittings
IS:2713	Tubular steel poles
IS:280	MS wire for general engg. Purposes
Conduits, Accessories and Junction Boxes	
IS:9537	Rigid steel conduits for electrical wiring
IS:3480	Flexible steel conduits for electrical wiring
IS:2667	Fittings for rigid steel conduits for electrical wiring
IS:3837	Accessories for rigid steel conduits for electrical wiring
IS:4649	Adaptors for flexible steel conduits
IS:5133	Steel and Cast Iron Boxes
IS:2629	Hot dip galvanising of Iron & Steel
Lighting Panels	
IS:13947	LV Switchgear and Control gear(Part 1 to 5)
IS:8828	Circuit breakers for over current protection for house hold and similar installations
IS:5	Ready mix paints
IS:2551	Danger notice plates
IS:2705	Current transformers
IS:9224	HRC Cartridge fuse links for voltage above 650V(Part-2)
IS:5082	Wrought aluminium and Al. alloys, bars, rods, tubes and sections for electrical purposes
IS:8623	Factory built Assemblies of Switchgear and Control Gear for voltages upto and including 1000V AC and 1200V DC
IS:1248	Direct Acting electrical indicating instruments
Electrical Installation	
IS:1293	3 pin plug
IS:371	Two to three ceiling roses

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**Annexure-G****MQP & INSPECTION LEVEL REQUIREMENT**

Sl. No.	Item / Equipment	Requirement of MQP/ITP/FAT	Inspection Level
1 A	Transformer /Reactor	Yes	IV
1 B	Circuit Breakers	Yes	IV
2	Current transformer	Yes	IV
3	Capacitive voltage transformers/Potential transformer	Yes	IV
4	Isolators	Yes	IV
5	Lightening Arrestors	Yes	III
6	Line Trap	Yes	III
7	Control & Relay Panels	Yes	III
8	Power Cables	Yes	III
9	Control Cables	Yes	III
10	LT Switchgear & ACDB/DCDB/MLDB/ELDB/ Lighting Panels	Yes	III
11	Fire protection system		
11-A	Panels, Deluge valve, Hydro pneumatic tank.	No	III
11-B	Strainers, extinguishers, MS/GI pipes, Pumps, motors, air compressor, and other valves, Diesel Engines	No	II
11-C	Others	No	I
12	Insulator (Disc, Long Rod, Solid Core)	Yes	IV
13	Conductor	Yes	IV
14	Clamps & Connectors (including equipment connectors)	Yes	III
15	Junction Box / Lighting Switch Boards / Bay MB/Telecom Equipment Cabinet	No	II
16	Cable lugs	No	I
17	Lighting Fixtures ,Lamps & fans	No	I
18	Switches	No	I
19	Conduits	No	I
20	Lighting Poles	No	II
21	MS/GI /PVC Pipes for cable trenches and lighting	No	I
22	Hume Pipes	No	I
23	Galvanized Cable trays	No	II
24	MS/ GI Flat and earthing material	No	II
25	MS Round for Earthmat (40mm dia)	No	I
26	Lighting Earthwire	No	I
27	Aluminium Tube & Busbar materials	No	II
28	Outdoor Receptacle	No	I
29	Nut / Bolts / Spring Washers (Gr 5.6/5)	No	II
30	LT Transformer	Yes	III
31	Battery	No	II
32	Battery Charger	Yes	III

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**Annexure-G**

Sl. No.	Item / Equipment	Requirement of MQP/ITP/FAT	Inspection Level
33	D. G. Set	No	II
34	Split A.C/window A.C.	No	I
35	Substation Automation system	No	III
36	Telephone wires	No	I
37	Telephone sockets	No	I
38	Aluminium ladder	No	I
39	Occupancy sensors for control of lighting	No	I
40	Sub Station Structure (lattice/pipe type)	Yes	III
41	HG fuse	No	II
42	PLCC equipment Viz PLCC Terminal ,Carrier equipment, Protection Coupler , Coupling Device but excluding EPAX / HF Cable/ SDH Equipment	Yes	III
43	HF Cable / GPS Clock	No	I
44	EPAX	No	I
45	Cable Glands / Joints /Clamps/ Termination	No	I
46	Video Monitoring System	No	II
47	Controller for switching	No	IV
48	Solar based street lighting pole including solar panel as per technical specification	No	III
49	Event Logger	No	III
50	Lighting transformers	Yes	II
51	String Hardware	Yes	IV
52	Test Equipment	No	I *
53	GS Earthwire	Yes	IV
54	Oil Storage Tank	Yes	III
55	Insulating Oil	No	III
56	Flow sensitive conservator isolation valve	No	II **
57	On-Line insulating oil drying system	No	II **
58	On line DGA & Moisture Analyzer	No	II **
59	WAMS-(PMU & Accessories)	Yes	III
60	FO Cable	Yes	III
61	Re-rollers of MS/HT Angle Section and galvanized tower parts.	Yes	IV
62	Hardware fittings & Earthwire Accessories	Yes	IV
63	OPGW & H/W	Yes	III
64	Bolts & Nuts Gr up to 5.6/5	Yes	II
65	Bolts & Nuts of Gr 8.8 / 8	Yes	IV
66	D-shackle/ Hanger / Links	Yes	IV
67	Danger Plate /Phase Plate / Number Plate / Circuit plate	No	I
68	Pipe Type & Counter Poise Earthing	No	II
69	Spring Washer	No	II
70	ACD & Barbed wire for ACD/Bird guard	No	II

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

Annexure-G

Sl. No.	Item / Equipment	Requirement of MQP/ITP/FAT	Inspection Level
71	Span Marker & Obstruction Light	No	III
72	GIS including spares	Yes	IV
73	GIS Bus Duct	Yes	IV
74	GIS Bushing	Yes	IV
75	SF6 Gas processing Unit	No	II
76	Partial Discharge Monitoring System	No	II
77	STATCOM including Valve, valve base electronics, DC capacitor, series reactor and all accessories	Yes	IV
78	Mechanically switched Reactor bank (3-ph) including all accessories (MSR Branches)	Yes	IV
80	Mechanically switched Capacitor bank (3-ph) including all accessories (MSC Branches)	Yes	IV
81	Pass Harmonic filters	Yes	IV
82	Valve cooling system	Yes	III
	FODP including pigtail	No	II
	Radio link Telecom	Yes	III
	Hardware Fittings for Fibre Optic approach cable	Yes	III
	SDH Equipments (ADM), PDH, Primary Multiplexer	Yes	IV
	Drop & Insert Multiplexer	Yes	IV
	DACS	Yes	IV
	Main Distribution Frame	No	I
	HDPE Pipe	No	II
	NMS, TMN	Yes	IV
	Synchronization Equipment	No	Level-I
93	HT Capacitor	Yes	IV
94	PLC Capacitor	Yes	III
95	48V DCPS	Yes	III
96	Nitrogen Injection system	Yes	III
97	Foundation/Anchor bolts	Yes	III
98	EOT crane/Lift	No	II
99	Optical Signal Column	No	II
100	Maintenance Platform	No	II
101	Spark Gap	Yes	III
102	Thyristor Valve	Yes	III
103	DC current & voltage measuring device	ITP	III
104	Furniture	No	I

Note:

- * MICC for test and measuring equipment shall be issued only after actual verification/demonstration of satisfactory performance at site.
- ** Though level-2 items, CIP can be issued also on review of TCs and visual inspection of these items.



Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV
Bhadla-2 (PG) S/s Extension under Transmission System
Associated With LTA applications from Rajasthan SEZ
Part-B (Rajasthan SEZ Part-B Project) through Tariff
Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00

SECTION-4

Checklist

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-61869-1 and 61869-2	Yes	
2.	Type of CT			
	a) Insulating medium	Oil/SF6	Yes	
	b) Installation	Outdoor	Yes	
	c) Tank design	Dead tank/ Live Tank	Yes	
3	Rated Frequency	50 Hz	Yes	
4	Voltage level			
	a) Nominal System Voltage	33kV	Yes	
	b) Highest System Voltage	36kV	Yes	
5	Rated current	As per Section-I	Yes	
6	Rated short time withstand current for 1 sec	25 kA for 3 sec.	Yes	
7	Rated extended current	120%	Yes	
8	Rated continuous thermal current rating	As per Section-II	Yes	
9	Rated Insulation Levels : a. Power Freq. Withstand Voltage b. Lightning Impulse withstand voltage	70kV (rms) 170kVp	Yes	
10	Creepage Distance	900mm	Yes	



**Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route.
33kV Current Transformer
Doc. No. : TB-409-510-007 Rev 00**

11	The CT Core Parameters	As per clause 1.3.1 and 2.6	Yes	
12	CT supplied Suitable for operation in the Climatic and High Altitude conditions.	Suitable for Climatic and Meteorological Data Specified in Section III	Yes	
13	Max. Temperature rise over design ambient temperature	IEC-61869-1 and 61869-2	Yes	
14	External Surface if steel	a. Hot Dip Galvanized b. Painted	Yes	
15	Earthing Conditions	Effectively Earthed	Yes	
16	Type Test report approval Extension.	POWERGRID approved type tests reports of tests (relevant to the offered CT) conducted not earlier than 05-Nov-2009. PGCIL Approval Letter comprising list of test reports to be submitted along with offer.	Yes	

B) TYPE TESTS

i) Whether type test reports of the tests as per relevant IEC-61869-1 and 61869-2 conducted earlier on identical or similar material are available (test reports are of the test conducted not earlier 05-Nov-2009.

(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