

SECTION: GENERAL TECHNICAL REQUIREMENTS**CONTENTS**

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1.0 FOREWORD

- 1.1 The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other sections of tender documents and is not exclusive. However, in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

2.0 GENERAL REQUIREMENT

- 2.1 The bidders shall submit the technical requirements, data and information as per the technical data sheets provided in the Section-7 of bid documents.
- 2.2 The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification.
- 2.3 It is recognized that the Contractor may have standardized 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 the Purchaser's. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the specific requisite schedule, will not be considered as valid deviation.
- 2.4 Except for lighting fixtures, 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. For lighting fixtures, makes shall be as defined in Section- Lighting System.
- 2.5 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 not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be **supplied**. All similar standard components/Parts of similar standard equipment provided shall be inter-changeable with one another.

- 2.6 Unless brought out clearly in the respective schedule of deviations, it will be considered that, the Bid proposal scrupulously conforms compliance to the specification. The bidders must bring out all the deviations in the bid proposal.
- 2.7 In case there is a discrepancy between the data of offered equipment and catalogue furnished, and unless the deviation are brought out clearly in the Technical Deviation Schedule, the equipment will be deemed to conform compliance to the specification scrupulously.

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, including CEA & grid code regulations, Indian Electricity rules, CBIP guidelines etc. Drawings shall specifically mention the rules applied during design / Engineering.
- 3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the 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 complement each other.
- 3.4 The Contractor shall also note that list of standards presented in this specification is not complete. Whenever

necessary the list of standards shall be considered in conjunction with specific IS/IEC.

- 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 in additional information schedule of Vol. III 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 Purchaser's approval.
- 3.7 The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be carried out.

4.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

- 4.1 The 420kV system is being designed to limit the switching surge over voltage of 2.5 p.u., and the power frequency over voltage of 1.5 p.u., In case of the 420kV system, the initial value of the temporary overvoltages could be 2.0 p.u. for 1 - 2 cycles. 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, 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 the

terminal connectors are required to withstand.

4.5 - A 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” and a corresponding key-erection diagram / drawing will be issued to owner / consultant.
- 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.
- c) All EHT equipments shall be suitable for hot line washing. If required, due to ambient pollution or other considerations, bidder shall include suitable silicon-based insulating coating in their offer, recording the reasons thereof.
- d) The supplier shall supply type tested equipments. The type test reports shall be furnished by the supplier along with bid and with equipment/ material drawings.
- f) After Award of contract to successful bidder, In the event of any discrepancy / deficiency found in supplied material / equipment or if any test report is not acceptable due to any design / manufacturing changes or due to non – compliance with the requirement stipulated in the technical specification or IEC/IS, then, rectification / replacement of the same shall be carried out by contractor without any additional cost to owner/Purchaser.

4.5 -B Operating times of circuit breakers, protective relays and PLCC equipment have been specified in respective sections. However bidder is allowed to have minor variations on the individual equipment timings subject to the condition that overall fault clearing time remains within 100ms.

4.6 EHV equipments and system shall be designed to meet the following major technical parameters as brought out hereunder.

4.6.1 System Parameter

SL No	Description of Parameters	400 kV System	220 kV System
1.	System operating voltage	400kV	220kV
2.	Maximum operating voltage of the	420kV	245kV
3.	Rated frequency	50Hz	50Hz
4.	No. of phase	3	3
5.	Rated Insulation Levels		
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	1425kVp	1050 kVp
ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	1050kVp	-
iii)	One minute power frequency dry withstand voltage (rms)	630kV	-
iv)	One minute power frequency dry and wet withstand voltage (rms)	-	460kV
6.	Corona extinction voltage	320kV	156kV
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 320KV rms for 400KV system	1000 micro-volt/ 500micro-volt for SA	1000 micro-volt
8.	Minimum creepage distance	25 mm/KV (10500 mm)	25 mm/KV (6125mm)
i.	Phase to phase	4200mm (for rod conductor configuration) 4000mm (for	2100mm
ii.	Phase to earth	3500 mm	2100mm
iii)	Sectional clearances	6500 mm	5000mm
9.	Rated short circuit current for 1 sec. duration	40/50/ 63kA for 1 Sec(as applicable)	40kA
10.	System neutral earthing	Effectively earthed	Effectively earthed
11.	Clearances		

i.	Phase to phase	3500 mm (for BIL-1300 kVp & SIL- 1050 kVp)	2000 mm (for BIL-950 kVp)
ii.	Phase to earth	3100 mm (for BIL-1300 kVp & SIL- 1050 kVp)	1800mm (for BIL-950 kVp)

Note :

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.
2. The insulation and RIV levels of the equipments shall be as per values given in the respective chapter of the equipments.

4.6.2 Major technical parameters of bushings / hollow column / support insulators are given below:

S.N.	Parameters	420 kV	245 kV	72.5kV
(a)	Max. System voltage Um(kV)	420	245	72.5
(b)	Impulse withstand voltage (dry & wet)	± 1425	± 1050	± 325
(c)	Switching surge withstand voltage (dry & wet) (kVp)	± 1050	=	=
(d)	Power frequency withstand voltage (dry and wet) (kV rms)	± 630	± 460	± 140
(e)	Total creepage distance (min)	10500	6125	1813
(f)	Insulator shall also meet requirement of IEC- 815 for 420 kV and 245 kV systems, as applicable having alternate long & short sheds			

4.6.3 Major Technical Parameters

The major technical parameters of the equipments are given below. For other parameters and features respective technical sections should be referred.

400/220/33kV Auto Transformer

Voltage ratio (kV)	400/220/33		
Rated frequency (Hz)	50		
Max. Design Ambient Temp. (°C)	50		
Windings	HV	IV	LV
(i) System Fault level (KA)	40/50/63	40	25
	(As applicable)		
(ii) 1.2/50 micro sec. impulse withstand voltage kVp	1300	950	250
(iii) 20/200/500 micro second switching surge withstand voltage kVp	1050	-	-
(iv) One minute power frequency voltage kV (rms)	-	-	95
(v) Winding connection	Star	Star	delta
(vi) Neutral	-Solidly grounded		
(vii) Insulation	-Solidly grounded		
(viii) Vector Group	- YN a0 d11 –		

For 400 KV Shunt Reactor & NGR

Shunt Reactor	
Rated Voltage (KV)	420 (1.0 pu)
System fault level (KA)	40/50/63 (As applicable)
(a) Lightning impulse 1.2/50 micro seconds withstand voltage (kVp)	1300
(b) Switching surge impulse 20/200/500 micro seconds voltage (kVp)	1050
Insulation level of neutral	
(a) Impulse withstand voltage (kVp)	550
(b) Power frequency voltage (rms)	230

Neutral Grounding Reactor

Rated voltage from insulation strength considerations (KV)	145	
Rated frequency (Hz)	50	
No. of Phases	One	
Insulation level for winding	Line Side	Ground Side
(i) Lightning impulse (1.2/50 micro seconds) withstand voltage (kVp)	550	95
(ii) One minute power frequency withstand voltage (kV rms)	230	38

For 420 kV Circuit Breaker and Isolator

Rated voltage (kV, rms)	420	
Rated frequency (Hz)	50	
No. of poles	3	
Design ambient temperature (°C)	50	
Rated Insulation levels :		
1) Full wave impulse withstand voltage (1.2/50 microsec.)		
- between line terminals and ground	±1425 kV peak	
- between terminals with circuit breaker/ kVp Isolator open		± 1425 kVp impulse on one terminal and 240 power frequency voltage of opposite polarity on other terminal
2) Switching impulse withstand voltage (250/2500 micro-second) dry and wet		
- between line terminals and ground	± 1050 kV peak	
- between terminals with circuit breaker/ Isolator open		900 kVp impulse on one terminal and 345 kVp power frequency voltage of opposite polarity on other terminal

3) One minute power frequency dry withstand voltage

- between line terminals and ground 520 kV rms

- between terminals with circuit breaker/ Isolator open 610 kV rms

Corona extinction voltage (kV rms) with Circuit Breaker/Isolator in all positions 320 (min)

Max. radio interference voltage (micro volts) for frequency between 0.5 MHz and 2 MHz at 266 kV rms. in all positions 1000

Minimum Creepage distance:-

i) Phase to ground (mm) 10500

ii) Between CB Terminals (mm) 10500

Phase to phase spacing 6000/7000mm(as applicable)

Seismic acceleration 0.3g horizontal

Thermal Rating of Auxiliary Contacts 10 A at 220 V DC

Breaking Capacity of auxiliary contacts 2 A DC with circuit time constant not less than 20 ms.

System neutral earthing Effectively Earthed

Auxiliary switch shall also comply with other clauses of this chapter.

420 kV CT/CVT/SA

Rated voltage (kV, rms) 420

Rated frequency (Hz) 50

No. of poles 1

Design ambient temperature (°C) 50

Rated Insulation levels :

- 1) Full Insulation levels :
 - between line terminals and ground for CT and CVT ± 1425 kV peak
 - For arrester housing ± 1425 kV peak
- 2) Switching impulse withstand voltage (250/2500 micro second) dry and wet
 - between line kVp peak terminals and ground for CT and CVT ± 1050
 - For arrester housing ± 1050 kV peak
- 3) One minute power frequency withstand voltage
 - between line terminals and ground for CT and CVT 630 kV rms. (dry)
 - For arrester housing 630 kV rms (dry & wet)

Corona extinction voltage (kV rms) for CT/CVT. 320 (min)

Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 266 kV rms (Micro volts) 1000 for CT/CVT
500 for SA

Min. Creepage distance :-

Phase to ground (mm) 10500

Seismic acceleration 0.3g horizontal

Partial discharge :-

 - for arrester at 1.05 COV Not exceeding 50 pc.
 - for CT/CVT Not exceeding 10 pC.

System neutral earthing Effectively Earthed

For 245 kV & 145 kV Circuit Breaker and Isolator

Rated voltage kV (rms)	245	145
Rated frequency (Hz)	50	50
No. of Poles	3	3
Design ambient temperature	50	50 temperature (°C)

Rated insulation levels :

- 1) Full wave impulse withstand voltage (1.2/50 micro sec.)
 - between line terminals and ground $\pm 1050 \text{ kVp}$ $\pm 650 \text{ kVp}$
 - between terminals with circuit breaker open $\pm 1050 \text{ kVp}$ $\pm 650 \text{ kVp}$
 - between terminals with isolator open $\pm 1200 \text{ kVp}$ $\pm 750 \text{ kVp}$
 - 2) One minute power frequency dry and wet withstand voltage
 - between line terminals and ground 460 kV (rms) 275 kV (rms)
 - between terminals with circuit breaker open 460 kV (rms) 275 kV (rms)
 - between terminals with Isolator open 530 kV (rms) 315kV (rms)
- Max. radio interference (microvolts) for frequency between 0.5 MHz and 2 MHz in all positions of the equipments.
- | | |
|----------------------|----------------------------|
| 1000 (at 156 kV rms) | 500 voltage (at 92 kV rms) |
|----------------------|----------------------------|

Minimum creepage distance :-

Phase to ground (mm)	6125	3625
Between CB Terminals (mm)	6125	3625

System neutral earthing

Effectively earthed
Effectively earthed

Seismic acceleration - 0.3g horizontal -

Rating of Auxiliary (applicable) Contacts 10 A at 220/110 V DC (as

Breaking capacity of Auxiliary Contacts 20ms.	2 A DC with circuit time constant of not less than
Phase to phase spacing (mm) 2700	4500 or 4000 3000 or

Auxiliary Switch shall also comply with other clauses of this chapter.

FOR 245 kV & 145 kV CT/CVT/SA

Rated voltage kV (rms)	245	145
Rated frequency (Hz)	50	50
No. of poles	1	1
Design ambient temperature (°C)	50	50

Rated insulation levels :

1) Full wave impulse withstand voltage (1.2/50 micro sec.)

- between line terminals ± 1050 kVp ±650 kVp and ground for C
- for arrester housing ± 1050 kV peak ±650 kVp

2) One minute power frequency dry and wet withstand voltage

- between line terminals 460 kV rms 275 kV rms
and ground for CT and CVT
- for arrester housing 460 kV rms 275kV rms

Max. radio interference 1000 for
CT/CVT 500 voltage (microvolts) for 500 for SA
frequency between 0.5 MHz (at 156 kV (at 92 kV
and 2 MHz in all positions rms) rms)
of the equipment.

Minimum creepage distance :-

Phase to ground (mm) 6125 3625

System neutral earthing - Effectively earthed -

Seismic acceleration - 0.3g horizontal -

Partial discharge for :-

- Surge arrester at - Not exceeding 50 pc. -
1.05 COV
- for CT/CVT - Not exceeding 10 pc. -

For 72.5 kV AND 36 kV EQUIPMENTS

Rated Voltage KV (rms)	72.5	36
Rated frequency (Hz)	50	50
No. of Poles	3	3
Design ambient temperature (°C)	50	3
Rated insulation levels :		
1) Full wave impulse withstand voltage (1.2/50 micro sec.)		
- between line terminals and ground	± 325 kVp	± 170 kVp
- between terminals with Isolator open	± 375 kVp	± 180 kVp
2) One minute power frequency dry and wet withstand voltage		
- between line terminals and ground	140 kV (rms)	70 kV (rms)
- between terminals with Isolator open	160 kV (rms)	80 kV (rms)
Minimum creepage distance :-		
Phase to ground (mm)	1813	900
Seismic acceleration	-- 0.3g horizontal --	
Rating of Auxiliary Contacts applicable)	10A at 220/110V DC (As applicable)	
Breaking capacity of Auxiliary Contacts	2 A DC with circuit time constant of not less than 20 ms.	
Phase to phase spacing (mm)	2000	1500

Auxiliary Switch shall also comply with other clauses of this chapter.

For 72.5 kV CIRCUIT BREAKER

1.	Rated continuous current (A) at design ambient temperature of 50 °C	1250
2.	Rated short circuit current breaking capacity at rated voltage	25 kA with percentage DC component as per IEC 62271-100 corresponding to minimum opening time under operating conditions specified.

3.	Symmetrical interrupting capability kA (rms)	25
4.	Rated short circuit making current kA (peak)	63
5.	Short time current carrying capability for one second kA (rms)	25
6.	Rated line charging interrupting current at 90 °C leading power factor angle (Arms) (The breaker shall be able to interrupt the rated line charging current with test voltage immediately before opening equal to the product of $U/\sqrt{3}$ and 1.4 as per IEC 62271-100	As per IEC
7.	Maximum allowable switching over voltage under any switching condition	As per IEC
8.	Total break time as per Clause 3.0 of Technical specification. (ms)	Less than 80
9.	Rated break time as per IEC (ms)	Less than 75
10.	Total closing time (ms)	Not more than 200
11.	Rated operating duty	O-0.3S-CO-3min-CO Cycle
12.	Operating mechanism	Pneumatic/ Spring/ hydraulic or a combination of these
13.	Trip coil and closing coil voltage	220 V DC with variation as specified in clause 8.2.5 of Tech. spec.
14.	Auxiliary contacts	Besides requirement of Technical specification, the contractor shall wire up 2 NO + 2 NC contacts for future use of Employer
15.	Noise level at base and upto 50m distance from base of breaker	140 bB (Max.)
16.	Rated terminal load	As per IEC or as per the value calculated in section 2 of each. Spec., whichever is higher.
17.	Temperature rise over the design ambient temperature	As per IEC 60694
18.	First pole to clear factor	1.5

19.	No. of terminals in common control cabinet	All contacts & control circuits to be wired out upto common control cabinet plus 10 Terminals exclusively for Employer's use.
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72.5 kV CURRENT TRANSFORMERS

1.	Rated Primary current	50A
2.	Rated extended current	120%
3.	Rated short time current	25 kA for 1 sec.
4.	Rated dynamic current	63 kAp
5.	Maximum temperature rise over design ambient temperature	As per IEC -60044-1
6.	One minute power frequency withstand voltage sec. terminal & earth	5 kV (rms)
7.	Number of terminals	All terminals of control circuits are to be wired upto marshalling box plus 20% spare terminals
8.	Type of insulation	Class A

72.5 KV VOLTAGE TRANSFORMERS OR CAPACITIVE VOLTAGE TRANSFORMERS

1.	System Fault level	25 kA for 1 second
2.	Standard reference range of frequencies for which the accuracies are valid	96% to 102% for protection and 99.5 to 101% for
3.	One minute power frequency withstand voltage for secondary winding	3 kV (rms)
4.	Number of terminals in control cabinet	All terminals of control circuits are wired upto marshaling box plus 20% spare terminals

72.5 kV ISOLATOR

1.	Rated voltage	72.5 kV
2.	Rated current	2000/400 A
3.	Standards	IEC 129

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4.	Rated short time withstand (in KA)	25 KA for 1 sec.
5.	Operating drive	AC Motor operated
6.	Type	Double break Isolator without E/S, 3 pole, outdoor, Gang operated
7.	Interlock	Mechanical pad lock to be provided to ensure no unauthorized operation
8.	Construction details	All ferrous parts to be galvanized except nuts and bolts which shall be electroplated as per relevant IS
9.	Terminal connector	To suit site conditions and layout requirements
10.	Operating time	12 seconds or less

REQUIREMENTS OF 72.5 KV VOLTAGE TRANSFORMERS

1.	Rated primary voltage (kV rms)	72.5
2.	Type	Single phase Electro-magnetic or Capacitive VT
3.	No. of secondaries	2
4.	Rated Voltage Factor	1.2 continuous 1.5- 30 seconds
5.	Phase angle error	± 20 minutes (For metering core)
		Secondary I Secondary II
6.	Voltage ratio	33/v3/0.11/v3 33/v3 /0.11/v3
7.	Application	Protection Metering
8.	Accuracy	5P 0.5
9.	Output Burden (VA) (minimum)	20 10

REQUIREMENTS FOR 72.5 KV CURRENT TRANSFORMER

No. of Cores	Core No.	Application	Current Ratio	Output burden (VA)	Accuracy class & AL as per IEC 44-1	Remarks
3	1	O/C&E/F	50/1	10	5P10	
	2	Metering	50/1	5	0.2	
	3	Spare	50/1	10	5P10	

36 KV SURGE ARRESTOR WITHOUT SURGE MONITOR

1.	Rated voltage of arrestor	30 KV
2.	Maximum continuous operating voltage (COV) at design ambient temperature	25 kv
3.	Standards	IEC 60099-4
4.	Normal discharge current (8/20 msec)	10 KA
5.	Minimum discharge capability (FJ/KV) referred	5.0 KJ/KV
6.	One minute Power Frequency (dry) withstand voltage of arrestor	80 KV rms
7.	Line discharge class as per IEC	3
8.	Maximum residual voltage at S.No. 4 above	85 KVp

36kV Isolator

1.	Rated voltage	36 KV
2.	Rated current	400 Amp.
3.	Standards	IS 9921/IEC 129
4.	Rated short time withstand (in KA)	25 KA for 1 sec.
5.	Operating drive	Manual operating mechanism
6.	Type	Double break Isolator w/o E/S 3 pole, outdoor, Gang operated.
7.	Constructed detail	All ferrous parts to be galvanized except nuts and bolts which shall be electroplated as per relevant IS.
8.	Terminal Connector	To suit site conditions and layout requirements.

5.0 ENGINEERING DATA AND DRAWINGS

- 5.1 The furnishing of engineering data by the Contractor shall be in accordance with the Schedule for each set of equipment as specified in the Technical Specifications

Minimum details required on drawings of different categories are given below:

List of Drawings: A detailed list of drawings which the Contractor proposes to prepare for site indicating therein drawing nos. and titles.

Schedule: i. All activities from the start date upto commissioning shall be included. Separate programmes shall be furnished for each of the activities of each substation/ site.
ii. Earliest and latest occurrence of each activity.
iii. Constraints, if any.

. The activities for each of the items shall essentially cover timetable for activities such as placement of order with sub-Contractors, engineering, submission of drawings, review and approval by the OWNER, manufacture, inspection, delivery, erection, testing and commissioning. All events shall be represented in a proper sequence of occurrence with due consideration for inter-dependent activities and all periods shall be counted from the start date.

The Contractor shall submit all working drawings, equipment data and detailed drawings. These shall include general arrangement, details of equipment, foundations, cable routing, openings in walls and floors, wiring diagrams, cable schedules, interconnection diagrams, etc. necessary for the erection of Substation.

- 5.2 The review of these data by the Owner 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 Owner 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 Owner shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

All engineering data submitted by the Contractor after final process including review and approval by the Owner 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 Owner in Writing.

5.2.1 DOCUMENTS

- The bidder must furnish a detailed list of drawings and documents along with the bid proposal which he intends to submit to the owner after award of the contract.
- Along with the drawings, bidder shall also submit technical reference manuals for the protection relays, BCU and other main equipment like SCADA, Circuit breakers etc which they themselves manufacture or otherwise propose to offer (bought-out equipment) as part of the scope of supply under these specifications.
- The contractor shall necessarily submit all the drawing/documents mentioned in these specifications unless anything is waived.

Type of Drawing	Minimum Details Required
One line diagrams	All equipment connections with ratings, polarities, protection and metering details etc.
	Cable details for all circuits.
	Details of relays, meters and major components associated with each circuit.
	Busbar details, makes of equipment/ components etc.
	Reference drawings.
General	Dimensional layout drawings Arrangement covering complete layout (Equipment, cabling, earthing, lightning protection, lighting etc.)
	Plans and sections as required to show details, access space/ clearances etc.
	Details of foundations, cutouts, openings, supporting/ mounting details etc.
	Bill of material and identification of components/rooms/areas etc.
	Reference drawings

- The contractor shall submit 4 (Four) sets of drawing / design documents / test reports or as may be discussed and finalized during pre-bid discussions as required for the approval by the owner.
- The successful bidder shall submit 4 sets of hard copies of

Erection & commissioning manuals along with the initial drawings submission. Two sets of non-editable soft copy (CD / DVD) format to be given.

- All engineering data submitted by the contractor after final process including review and approval by the owner 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 Owner in Writing.

5.3 Drawings

- 5.3.1 All drawings submitted by the Contractor including those submitted at the time of bid shall be in adequate size for easy visibility and with sufficient details to indicate the type, size, arrangement, detailed material description, Bill of Materials including ratings / makes, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, interfacing details and references to connected drawing, fixing arrangement required and any other information specifically requested in the specifications.

Following drawings/ documents shall be furnished along with the bid

- a) Write-up on the electrical system operation philosophy
- b) Write-ups on salient features and design concepts used
- c) Write-up on shop tests and site tests
- d) Quality assurance program
- e) Single line diagram for the complete electrical system with ratings, control measurement and protection schemes
- f) Motor list / electrical load list for all AC and DC loads
- g) Block Logic diagrams
- h) Contractors experience list of associated systems
- j) Bill of quantity

- 5.3.2 Each drawing submitted by the Contractor shall be clearly marked with the name of the Purchaser and owner, consultant's name, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in

English. All the dimensions should be in metric units.

- 5.3.3 Further work by the Contractor shall be in strict accordance with the final approved drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.
- 5.4 The review of these data by the Purchaser 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 Purchaser 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 Purchaser shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.
- 5.5 All manufacturing and fabrication work in connection with the equipment, prior to the final approval of the drawings for manufacturing, shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser as per guidelines in this specifications. Approval of Contractor's drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.
- 5.6 All engineering data submitted by the Contractor after final process including review and approval by the Purchaser shall form part of the Contract Document and the entire works

5.7 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/ to be furnished by the Owner would be discussed and finalised at the time of award. The Contractor shall also submit Four (4) copies of all drawings/design documents/test reports for approval of the Owner. The following schedule shall be followed generally for approval.

i) Approval/ comments/ by

KARNATAKA POWER TRANSMISSION CORPORATION LIMITED

Owner on initial submission Of receipt	Within 4 (Four) weeks
ii)Resubmission (whenever required) weeks from postal	Within 2 (Two) Date of comments (including both ways time).
iii)Approval or comments	Within 2 (Two) weeks of receipt of resubmission.
iv)Furnishing of distribution Copies	2 weeks from the date of final approval

Notwithstanding the time schedule indicated for approvals, the contractor (successful bidder) shall be responsible for completing the works in stipulated time as per approved PERT Chart.

NOTE:The contractor may please note that all resubmission must incorporate all comments given in the prior submission by the Owner or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

The drawings which are required to be referred frequently during execution should be submitted on cloth lined paper.

5.8. Other requirements of Documentation.

- 5.8.1 The CONTRACTOR shall furnish three (3) copies on CDs in AutoCAD-2012 format of all certified (Approved) equipment/ system drawings along with eight (8) copies of full size prints. In addition, one (1) copy on CDs in AutoCAD-2012 format of all certified (Approved) equipment/ system drawings along with four (4) copies of full size prints shall be submitted to Chief Engineer Elec., (T&P), Chief Engineer Elec (P&C) KPTCL, Bangalore after approval of drawings,
- 5.8.2 The manufacturer shall also submit one video Compact Disk/ Digital video disk (VCD/DVD) per substation and one for Chief Engineer, Electricity, (Tendering & Procurement), KPTCL,

Bangalore highlighting installation and maintenance techniques / requirements of Circuit Breaker and isolators.

- 5.8.3 On completion of the entire works, the Contractor shall also furnish eight bound sets of all as built drawings, duly signed by the site in-charge along with 4 sets of copies on CDs/DVDs both in pdf and Autocad for each substation to Chief Engineer, Electricity, (Tendering & Procurement), KPTCL, Bangalore, with as built drawings in AutoCAD-2012 or better.

12 (8+2+2) copies of instruction/operation manuals per substation to Chief Engineer, Elec., Tendering & Procurement, KPTCL, Bangalore shall also be furnished. The instruction manuals shall contain full details of drawings of equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and over hauling procedures.

After approval of test reports , 6(six) bound sets containing all drawings/manuals, type and routine test reports etc., along with sub-vendor's test reports for all bought out assemblies/components/ parts including internal wiring diagrams and exploded diagrams of assemblies/components / parts, shall be furnished.

- 5.8.4 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 Contractor to the Owner.

The contractor shall furnish to the Owner, spare parts catalogues also.

5.9 COLOUR SCHEME AND CODES FOR PIPE SERVICE

- 5.9.1 The contractor shall propose a colour scheme for the those equipments/ items for which the colour scheme has not been specified in the specification for the approval of Owner. The decision, of Owner shall be final. The scheme shall include:

- Finishing colour of indoor equipment.
- Finishing colour of outdoor equipment

- Finish colour of all cubicles.
- Finishing colour of various auxiliary system equipment including piping.
- Finishing colour of various building items.

5.9.2 All steel structures, plates etc., shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all Owner's electrical equipment in Owner's switchyard are painted with shade 697 of IS-5. All the indoor cubicles shall be of same colour scheme and for other miscellaneous items colour scheme will be approved by the Owner.

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 Incase where the equipment, materials or components are indicated in the specification as “similar” to any special standard, the Purchaser shall decide upon the question of similarity. When required by the specification or when required by the Purchaser the Contractor 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 being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

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 fulfill 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 Purchaser.

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.

6.1.5 All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s).

Only first-class work in accordance with the best modern practices will be accepted.

Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, levelling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in

accordance with the manufacturer's tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purposes.

The spare equipment(s) shall be installed at designated locations and tested for healthiness.

6.1.6 The Contractor 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 Contractor 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 Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.
- 6.1.8 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 B respectively.

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-airconditioned 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 240 V 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.
- 6.2.1.3 Suitable anti condensation heaters with the provision of thermostat shall be provided.

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. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air / dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

6.2.4 Degree of Protection

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

- a) Installed outdoor: 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 degree of protection test, on each type of the box 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 Purchaser. 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 SF6 GAS, CONSUMABLES, OIL AND LUBRICANTS

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 successful Operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

7.0 DESIGN IMPROVEMENTS / COORDINATION

- 7.1 The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. However, the Owner / Purchaser or the Contractor may propose changes in the specification of the equipment or quality thereof and if the Purchaser & contractor agree upon any such changes, the specification shall be modified accordingly.
- 7.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.
- 7.3 The Contractor 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 Contractor has to coordinate designs and terminations with the agencies (if any) who are

Consultants/Contractor for the Purchaser. The names of agencies shall be intimated to the successful bidders.

- 7.5 The Contractor will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the Consultants of the Purchaser (if any) during the period of Contract. The Contractor shall attend such meetings at his own cost at KPTCL Corporate Centre, Bangalore 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 Contractor's Works or at his Sub-contractor's premises or at the Purchaser's site or at any other place of Work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be broadly outlined by the contractor and finalised after discussions before the award of contract. The detailed programme shall be submitted by the contractor after the award of contract and finally accepted by **KPTCL** after discussion. However, in case detailed valid programme approved by KPTCL for the equipment already exist, same would be followed till its validity. A quality assurance programme of the contractor shall generally cover the following:

- (a) His organisation structure for the management and implementation of the proposed quality assurance programme;
- (b) Documentation control system
- (c) Qualification data for bidder's key personnel;
- (d) The procedure for purchases of materials, parts components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- (e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;

- (f) Control of non-conforming items and system for corrective actions;
- (g) Inspection and test procedure both for manufacture and field activities.
- (h) Control of calibration and testing of measuring instruments and field activities;
- (i) System for indication and appraisal of inspection status;
- (j) System for quality audits;
- (k) System for authorizing release of manufactured product to the Purchaser.
- (l) System for maintenance of records;
- (m) System for handling storage and delivery; and
- (n) A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

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

8.2 Quality Assurance Documents

The contractor shall submit a monthly updated progress report on the status of all drawing/engineering, procurement & supply, manufacturing & inspection activities of all the equipment under the scope of the contract – whether manufactured by contractor himself or his sub-vendor (Bought out).

The Contractor shall be required to- submit the following Quality Assurance Documents within three weeks after dispatch of the equipment.

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

- b) Welder and welding operator qualification certificates.
- c) Welder's identification list, listing welders and welding operator's qualification procedure and welding identification symbols.
- d) Raw material test reports oil components as specified by the specification and/or agreed to in the quality plan.
- e) Stress relief time temperature charts/oil impregnation time temperature charts.
- f) Factory test results for testing required as per applicable codes/mutually agreed quality plan standards referred in the technical specification.
- g) The quality plan with verification of various customer inspection points (CIP) as mutually agreed and methods used to verify the inspection and test points in the quality plan were performed satisfactorily.

9.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

9.1 The owner/Purchaser, his duly authorized representative and/or outside inspection agency acting on behalf of the owner/Purchaser shall have at all reasonable times free access to the contractor's / supplier's/ Sub-vendor premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship at the works during its manufacture or erection. If part of the works is being manufactured or assembled at other premises or works, the contractor shall obtain from the owner or his duly authorized representative permission to inspect as if the works were manufactured or assembled on the contractors own premises or works inspection may be made at any stage of manufacture, dispatch or at site at the option of the owner and the, equipment if found unsatisfactory due to bad workmanship or quality, Material is liable to be rejected. The contractor / supplier shall also make suitable arrangements to ensure that the contractor's / sub-vendor's representative accompanies the Owner's / Purchaser's representative during their visit to their works & assist them for gaining required information.

9.2 All equipments / materials being supplied shall conform to type test

- s including additional type test and shall be subject to routine tests in accordance with requirements stipulated under respective sections. The contractor shall intimate the owner the detailed programme about the test at least 3 weeks in advance in case of domestic supplies & 6 weeks in advance in case of foreign.

9.3 **TYPE**

TESTS:

Type tested equipments shall be offered. Refer respective clauses for validity period of various equipments. The type test reports shall not be older than the validity period of respective equipment as on the last date of submission of bid. The type tests are to be conducted again without any extra cost to the owner in case the type test reports are older than the validity period of respective equipment as on the last date of submission of bid. The type test charges are to be indicated in the schedule. The owner reserves right to insist for conducting all or a few type tests even though the type tests are less than the validity period of respective equipment as on the last date of submission of bid, the payment in such cases will be made as per the rates in the schedule.

9.4 **a) For Equipments manufactured in India:**

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

b) For Equipments manufactured Abroad:

- i). Type tests on imported equipment should have been conducted in an Indian Laboratory or foreign laboratory

accredited by National accreditation body of the country where the Type test has been conducted.

- ii). The type tests conducted in-house by a manufacturer shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests has been conducted in the presence of a representative of accredited laboratory or any of the purchasing utilities or CEA in that order. Such type test reports shall record the details of such witness including the signature/authentication in the type test report.

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

- 9.5 The contractor shall give the owner/ inspector thirty (30) days written notice of any material being ready for joint testing. Such tests shall be to the contractor's account except for the expenses of the Inspector. The owner/ inspector, unless witnessing of the tests is waived in writing, will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/ inspection, failing which the contractor may proceed with the test which shall be deemed to have been made in the owner's/ inspector's presence and he shall forthwith forward to the owner/ inspector duly certified copies of tests in triplicate. The owner or inspector shall, within fifteen(15) days from the date of inspection as defined herein give notice in writing to the contractor, of any objection to any drawings and all or any equipment an workmanship which in his opinion is not in accordance with the contract. The contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the owner/ inspector giving reasons therein, that no modifications are necessary to comply with the contract.

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

found not to comply with the contract. The equipment shall be dispatched to site only after approval of test reports and issuance of delivery advice by the owner.

- 9.7 In all cases where the contract provides for tests whether at the premises or at the works of the contractor or of any sub-contractor, the contractor except where otherwise specified shall provide free of charge such items as labor, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the owner/inspector or his authorized representative to carry out effectively such tests of the equipment in accordance with the contract and shall give facilities to the owner/ inspector or to his authorized representative to accomplish testing.
- 9.8 The inspection by owner and issue of inspection certificate thereon shall in no way limit the liabilities and responsibilities of the contractor in respect of the agreed quality assurance program forming a part of the contract.
- 9.9 The owner will have the right of having at his own expenses any other test(s) of reasonable nature carried out at contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.
- 9-10 The owner reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipments for these tests shall be provided by the Owner.

10.0 TESTS

10.1 Pre-commissioning Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Purchaser and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in respective chapters and shall be included in the Contractor's quality assurance programme. It is in the scope of the contractor to conduct all the necessary pre-commissioning & commissioning tests on all equipment & material supplied by him under the scope of this contract /

specifications. The contractor shall, at his cost, arrange all necessary tools, tackles & any special testing instruments / equipment as required for conducting the said testing. The contractor shall also arrange for these tests to be conducted by a competent agency, duly licensed by the relevant statutory authority of the state in which the works under the scope of these specifications is being executed. All the testing tools, tackles & special testing equipment / instruments shall be duly calibrated up-to-date, traceable to national / international standards and valid calibration certificates submitted to owner as part of the test-records.

10.2 Commissioning Tests

- 10.2.1 The calibrated Instrumentation and control equipment will be used by contractor, during performance of such tests and the Owner will witness the tests. However, immeasurable parameters shall be taken into account in a reasonable manner by the Owner for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The owner/Purchaser & consultant will approve any calculation tables / formulae / empirical law which contractor shall prepare apply proper corrections / calculation, to extrapolate the measured values conditions which do not correspond to the specified / rated operating conditions.
- 10.2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.
- 10.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.
- 10.3 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed by KPTCL on production of requisite documents.

11.0 PACKAGING & PROTECTION

- 11.1 All the equipments shall be suitably protected against all weather conditions, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. The above

mentioned packaging & Protection instructions shall also include the possibility that the equipment may need to be stored in outdoor all-weather conditions till the time of erection and should be protected / guarded / packed accordingly. On request of the Purchaser, the Contractor shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Purchaser to repack any equipment/material at a later date, in case the need arises. While packing and transporting all the materials, the limitation from the point of view of availability of Railway wagon sizes in India, constraints in transporting via roadways and all statutory rules & regulations thereof should be taken into account by the contractor while planning. The Contractor 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 Contractor. Purchaser takes no responsibility of the availability of the wagons or any other means of transportation envisaged by contractor for delivering the equipment / material to site. It is the responsibility of contractor to ensure that the route is safe and all clearances from Telecommunication / Electrical power lines are available, especially while transporting outsized / overweight equipment / materials/consignment

- 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. High tensile steel nuts & bolts and spring washers shall be electro galvanized to service condition
- 4.** 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 thickness of coating shall be 85 microns for all items thicker than 6mm. 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 treatment shall be provided to avoid formation of white rust after hot dip galvanization.
- 12.2.4 The galvanized steel shall be subjected to six 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 zinc rich paint at

site shall not be allowed.

12.3 PAINTING

- 12.3.1 All sheet steel work shall be de-greased, 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 swaf 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 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 color 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 alongwith the Bids for Purchaser's review & approval.

12.3.6 **VOID**

- 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 power (coating thickness of 60 microns) after surface preparation for painting.

13.0 HANDLING, STORING AND INSTALLATION

- 13.1 In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test, commission and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.
- 13.2 Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.
- 13.3 In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following

manufacturer's drawings/instructions correctly.

- 13.4 Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.
- 13.5 Contractor shall be responsible for examining all the shipment and notify the Purchaser immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. The Contractor shall submit to the Purchaser every week a report detailing all the receipts during the week and cumulative up-to-date receipts. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
- 13.6 The Contractor shall be fully responsible for the equipment/material until the same is handed over to the Purchaser in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Purchaser, as well as protection of the same against theft, element of nature, corrosion, damages etc.
- 13.7 Where material / equipment is unloaded by Purchaser before the Contractor arrives at site or even when he is at site, Purchaser by right can hand over the same to Contractor and there upon it will be the responsibility of Contractor to store the material in an orderly and proper manner.

- 13.8 The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment which requires indoor storage.
- 13.9 The words 'erection' and 'installation' used in the specification are synonymous.
- 13.10 Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.
- 13.11 The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances as given in clause 4.7.1 the Contractor shall immediately proceed to correct the discrepancy at his risks and cost.

13.12 Equipment Bases

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

14.0 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to Site.

15.0 AUXILIARY SUPPLY

- 15.1 The sub-station auxiliary supply is normally met through a system indicated under section "Electrical & Mechanical Auxiliaries" having the following parameters. 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 to the parameters as indicated in the following table

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/ Wire	Available / To be derived
415V	$\pm 10\%$	$50 \pm 5\%$	3 / 4 Wire	Solidly Earthed.
240V	$\pm 10\%$	$50 \pm 5\%$	1/2 Wire	To be derived by Contractor from the 3-phase, 415V supply by installing adequately rated Transformer.
220V	190V to 240V	DC	-	Isolated 2 wire System
230V	190V to 250V	AC	(50Hz UPS)-	Isolated 2 wire System derived by installing a UPS capable of taking the 220VDC battery back-up from Station Battery bank / DCDB.

Combined variation of voltage and frequency shall be limited to $\pm 10\%$.

16.0 SUPPORT STRUCTURE

16.1 The equipment support and Towers/Beams structures shall be suitable for equipment connections at the required levels as designed and Engineered for a “One-and-a-Half Breaker” Switching scheme. The level measurements shall be with reference to the finished ground (FGL) level of the 420 kV substations respectively which shall be considered “ZERO REFERENCE LEVEL”. All equipment support structures shall be supplied along with brackets, angles, stools etc. for attaching the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.

16.2 The equipment support and Towers / Beams

structures should be hot dip galvanised with minimum 610 gram/sq.m net of zinc.

16.3 In case of any deviation in this regard the bid is liable to be considered technically non responsive and shall be liable to be rejected.

16.4 Support structure shall meet the following mandatory requirements:

16.4.1 The minimum vertical height – ie. The vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the Support-structure base, where it rests on the foundation pad shall be 2.55 metres.

17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

17.1 All power clamps and connectors shall conform to IS:5561 & NEMA CC1 and shall be made of materials listed below :

- | | | |
|----|---|---|
| a) | For connecting casting, ACSR conductors

A6 | Aluminum alloy conforming to designation

of IS:617 and all test shall conform to IS:617 |
| b) | For connecting made equipment ter-casting, minals made of designation A6 copper with ACSR conductors test | Bimetallic connectors from aluminum alloy conforming to of IS:617 with 2mm thick bimetallic liner and all shall conform to IS:617 |
| c) | For connecting G.I wire | Galvanised mild steel shield |
| d) | i) Bolts, nuts & Plain,

ii) Spring washers for items 'a' to 'c' | Electrogalvanised for sizes below M12, for dip galvanised.

Electro-galvanised mild steel suitable for atleast service condition-3 as IS:1573 |

- 17.2 Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor terminations of equipment shall be either expansion, sliding or rigid type suitable for a) Quad/Twin Moose ACSR with 450mm sub conductor spacing and/or 5" and/or 4" IPS Aluminum Tube (OD:114.2mm, ID 97.18 mm) for 400kV Side, b) Quad & Twin Moose ACSR with 250 mm sub conductor spacing (to be used for main & transfer bus) and 4" IPS Aluminum Tube (OD:114.2mm, ID 97.18 mm) for 220kV side.. The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.
- 17.3 Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Purchaser by the Contractor.
- 17.4 Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of Work.
- 17.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body for Bi-metallic clamps.
- 17.6 All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- 17.7 Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of 5" or/ and 4" IPS AL. tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.

- 17.8 Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.
- 17.9 All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 17.10 Clamps and connectors shall be designed to be corona controlled. Corona extinction voltage for 400KV & 220kV class clamps shall not be less than 320KV (rms) & 156kV(rms) respectively and R.I.V. level shall not be more than specified 1000 micro volts for 400 kV & 220kV system at the test voltage specified in respective sections.

17.11 Tests

- 17.11.1 Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports on three samples of similar type shall be submitted for approval as per clause 9.2 above except for sl. no.(ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last five years shall not be applicable).
- i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)
 - ii) Short time current test
 - iii) Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)
 - iv) Resistance test and tensile test

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 sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be atleast 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum 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 Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements. A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes / Control cabinets to prevent ingress of rain water.
- 18.4 All the outdoor Cabinet/boxes shall be provided with double doors (Outer door and inner door). The doors shall be hinged with padlocking arrangements. The distance between two hinges shall be as less as possible as required to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.
- 18.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. The quality of gasket shall be such that it does not get damaged/ cracked during the ten years of operation of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.
- 18.6 All boxes/cabinets shall be designed for the entry of cables from bottom 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 projecting at least 150 mm 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, 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 For illumination, a 20 Watts fluorescent tube or 15 watts CFL 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 rotary switch type and Toggle/piano switches shall not be accepted.
- 18.10 Positive 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
 - a) The following routine tests along with the routine tests as per IS:5039 shall also be conducted:
 - i) Check for wiring
 - ii) Visual and dimension check
 - b) The enclosure of bay marshalling kiosk, junction box, terminal box shall conform to IP-55 as per IS:13947 including application of, 2.5 KV rms for 1 (one) minute, insulation resistance and

functional test
after IP-55 test.

19.0 AUXILIARY SWITCHES (APPLICABLE FOR ISOLATORS AND CIRCUIT BREAKERS)

The following type test reports on auxiliary switches shall be submitted for approval:

- (a) Electrical endurance test - A minimum of 2000 operation for 2A D. C. with a time constant greater than or equal to 20 millisecond with a subsequent examination of mV drop/visual defects/temperature rise test.
- (b) Mechanical endurance test. A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.
- (c) Heat run test on
- contacts. (d) IR/HV
- test etc.

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/Trays. All interphase and external connections to equipment or to control cubicles will be made through separate terminal blocks.
- 20.2 Terminal blocks shall be 1100 V 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 preferably the terminal blocks shall be non-disconnecting stud type of Elmex or Phoenix or Wago or equivalent make.
- 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 separate 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.
- 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 CT circuits | Minimum of two of 2.5 sq mm copper flexible. |
| b) | All CT / PT circuits | Minimum of 4 nos. of 6 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.
- 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. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm.
- 20.13 The Contractor 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 overvoltages 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 Contractor 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 AND SOCKETS

21.1 Lamps

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

21.2 Sockets

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.

21.3 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.

21.4 Switches and Fuses:

- 21.4.1 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 / switchfuse 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.

- 21.4.2 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-60233/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 silicon rubber insulator, conforming to IEC-61109.

- 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 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. The type test reports shall be submitted for approval.

23.0 MOTORS

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

23.1 Enclosures

- a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP-44 as per IS: 4691.
- b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
- c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.
- d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

23.2 Operational Features

- a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.
- b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

23.3 Starting Requirements:

- a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
- b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
- c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.
- d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 15.0 shall be capable of withstanding at least two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.
- e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the

Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

23.4 Running Requirements:

- a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.
- b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
- c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

23.5 TESTING AND COMMISSIONING

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

- (a) Insulation resistance.
- (b) Phase sequence and proper direction of rotation.
- (c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.

24.0 TECHNICAL REQUIREMENT OF EQUIPMENTS

24.1 VOID

24.2 VOID

24.3 VOID

24.4 Circuit Breakers (Applicable for 400kV,220kV &132kV)

24.4.(i) a) The manufacturer(s) whose SF6 Circuit Breaker are offered should have designed, manufactured tested as per IEC/IS or equivalent standard supplied the same for the specified system voltage and **40kA fault level (Applicable for 400kV) or above class** which are in satisfactory operation for at least 2 (two) years as on the date of bid opening

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@ 24.4.(i) b) In addition to the above the offered 400kV Circuit Breaker should have been designed, manufactured, type tested to specified fault level in the subject package & supplied and which must be in satisfactory operation as on the date of bid opening.

@ Clause applicable for 400kV class Breaker for fault level more than 40kA.

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24.4.(ii)(a) The manufacturer(s) whose SF6 Circuit Breaker are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 24.4.(i) (a) & (b)\$ given above.

\$24.4.(i)(b) applicable for 400kV Class Breaker for fault level more than 40kA.

And

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

And

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

(OR)

- # 24.4.(iii) 400 kV class Circuit breaker can also be offered from Indian manufacturer(s) who meet 24.4.(i) (a) but do not meet 24.4.(i) (b) above however in such case maximum up to thirty three percent (33%) quantity of the Circuit Breaker can be supplied by such manufacturer with additional warranty of two(2) years over and above the warranty period stipulated for the complete package and balance quantity of Circuit Breaker (i.e. at least sixty six percent (66%)) shall be necessarily supplied from a manufacturer meeting 24.4.(i) (a) & (b).

Clause applicable for 400kV Class Breaker for fault level more than 40kA.

24.5 Isolators (Applicable for 400kV, 220kV & 132 kV)

- 24.5.(i) (a) The manufacturer whose isolator are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the isolator for the specified system voltage and and 40kA fault level (Applicable for 400kV) or above class and should be in satisfactory operation for at least 2 (two) years as on the date of bid opening and

- @ 24.5.(i) b) In addition to the above the offered 400kV Isolator should have been designed, manufactured, type tested to specified fault level in the subject package & supplied and which must be in satisfactory operation as on the date of bid opening.

@ Clause applicable for 400kV class Isolator for fault level more than 40kA.

Or

- 24.5.(ii)(a) The manufacturer(s) whose Isolator are offered who have recently

established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company or collaborator (Principal) or collaborator meets qualifying requirements stipulated under clause no 24.5.(i) (a) & (b)\$ given above.

\$ 24.5.(i)(b) applicable for 400kV Class Isolator for fault level more than 40kA.

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

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

(OR)

24.5.(iii) 400 kV class isolator can also be offered from Indian manufacturer(s) who meet 24.5.(i) (a) but do not meet 24.5.(i) (b) above however in such case maximum up to thirty three percent (33%) quantity of the isolator can be supplied by such manufacturer with additional warranty of two(2) years over and above the warranty period stipulated for the complete package and balance quantity of isolator (i.e. at least sixty six percent (66%)) shall be necessarily supplied from a manufacturer meeting 24.5.(i) (a) & (b).

#Clause applicable for 400kV Isolator for fault level more than 40kA.

24.6 Instrument Transformers (Applicable for 400kV, 220kV & 132 kV)

24.6.(i) (a) The manufacturer whose instrument transformers are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the same for the specified system voltage for CT & CVT and 40kA fault level (Applicable for 400kV CT) or above class. These equipment should be in satisfactory operation for at least 2 (two) years as on the date of bid opening

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@ 24.6.(i) b) In addition to the above the offered 400kV Current transformer should have been designed, manufactured, type tested to specified fault level in the subject package & supplied and which must be in satisfactory operation as on the date of bid opening.

@ Clause applicable for 400kV class Current Transformer for fault level more than 40kA.

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24.6.(ii)(a) The manufacturer(s) whose Instrument Transformer are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 24.6.(i) (a) & (b)\$ given above.

\$ 24.6.(i)(b) applicable for 400kV Class Current Transformer for fault level

more than 40kA

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

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

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- # 24.6.(iii) 400 kV class Current Transformer can also be offered from Indian manufacturer(s) who meet 24.6.(i) (a) but do not meet 24.6.(i) (b) above however in such case maximum up to thirty three percent (33%) quantity of the Current Transformer can be supplied by such manufacturer with additional warranty of two(2) years over and above the warranty period stipulated for the complete package and balance quantity of Current Transformer (i.e. at least sixty six percent (66%)) shall be necessarily supplied from a manufacturer meeting 24.6.(i) (a) &(b).

Clause applicable for 400kV Current Transformer for fault level more than 40kA

24.7 Surge Arresters (Applicable for 400kV)

- (a) The manufacturer whose Surge Arresters are offered should have designed, manufactured and tested as per IEC/IS or equivalent standard and supplied the Surge Arrester for the specified energy capability with rated system voltage and which are in satisfactory operation for at least 2 (two) years as on the date of bid opening.

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- (b) The manufacturer(s) whose Surge Arrestors are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no (a) given above.

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

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

24.8 1.1 KV Grade Power & Control Cables

24.8.1 Applicable for PVC Control Cable

The manufacturers, whose PVC control cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 100 Kms of 1.1 KV grade PVC insulated control cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 27C x 2.5 Sq.mm or higher size as on the date of bid opening.

24.8.2 Applicable for PVC Power Cable

The manufacturer, whose PVC Power Cables are offered, should have designed, manufactured, tested and supplied in a single contract atleast 100 Kms of 1.1 KV or higher grade PVC insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 150 Sq. mm or higher size as on the date of bid opening.

24.8.3 Applicable for XLPE Power Cables

The Manufacturer, whose XLPE Power cables are offered,

should have designed, manufactured, tested and supplied in a single contract atleast 25 Kms of 1.1 KV or higher grade XLPE insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 630 Sq. mm or higher size as on the date of bid opening.

- 24.9 LT Switchgear : Refer Section-LT switchgear of specification
- 24.10 Battery and Battery Charger – Refer Section - Battery and
Charger Specification
- 24.11 LT Transformers – Refer Section - LT Transformers Specification
- 24.12 Fire Fighting System
The bidder or his sub-vendor should have designed, supplied, tested, erected and commissioned at least ten numbers/packages of fire protection system of the each type described in (i), and (ii) below in installations such as power plants, 400kV substations, . Such systems must have been designed to the recommendations of Tariff Advisory Committee of India or any other international reputed authority like (FOC, London or NFPA, USA etc.) executed during last ten (10) years and should have been in successful operation for at least 2 years as on the date of bid opening.
- (i) NITROGEN FIRE PROTECTION system
 - (ii) Smoke detection and Alarm system.
- 24.13 Control and Relay Panels (400 kV & 220kV)
- 24.13.1 The manufacturer whose C&R panels and protective relay are offered should have designed, manufactured, tested, installed and commissioned C&R panels including protection relays which must be in satisfactory operation on (i) specified voltage level or above [for 400 kV substation] for at least 5 (Five) years on the date of bid opening.
- 24.13.2 The C&R Panel from a manufacturer who has designed,

manufactured, tested, installed and commissioned C&R panels which are in satisfactory operation on (i) 400 kV system or above [for 400 kV & above substation] at least 2 (two) years on the date of bid opening can also be offered, provided the protective relay schemes should be offered from a Contractor who fully meets the requirements stipulated under clause 24.13.1 above.

Further, in such an event the manufacturer shall furnish an undertaking jointly executed by him and his protective relay schemes Supplier, as per the format enclosed in the bid documents for successful performance of the protection system offered.

24.14 PLCC (400 kV& 220kV)

24.14.1 The manufacturer whose PLCC panels are offered should have designed, manufactured, tested, supplied and commissioned PLCC panels for i) 400kV system for 400 kV substation, ii)220kV system or above [for 220kV sub-station] and the same should be in successful operation for atleast 2 (two) years as on the date of bid opening.

24.14.2 The manufacturer whose line traps are offered should have designed, manufactured tested, supplied and commissioned similar line traps for (i) 400kV system or above voltage level and 40/50/63kA fault level [for 400 kV substation] , ii) specified voltage level or above and specified fault level [for 220kV sub-station] and should be in successful operation for atleast 2 (two) years as on the date of bid opening.

24.14.3 PLCC Panels/line traps manufactured by the manufacturer meeting the requirements at Clause No. 24.14.1 & 24.14.2 except that the PLCC Panels/line traps manufactured, tested and supplied by them is not in operation for the stipulated period can also be offered provided the manufacturer furnishes an undertaking jointly executed by him and his collaborator, who in turn fully meets the requirement specified at 24.14.1/24.14.2 above as per the format enclosed in the bid document for successful performance of the equipment offered.

24.15 Substation Automation System

24.15.1 The substation automation system shall be offered from a manufacturer who must have designed, manufactured, tested, installed and commissioned substation automation

system which must be in satisfactory operation for 220kV & above Substation for at least 2 (Two) years as on the date of bid opening.

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

1. General

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

2. Test Levels:

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

3. Test Methods for RIV:

- 3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 Mhz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.
- 3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.
- 3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.
- 3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 765kV, 400 kV, 220 KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

- 3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.
- 3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by 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 RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

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

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

- 4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.
- 4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.
- 4.4 However, both tests shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.
5. Test Records:
In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:
- a) Background noise before and after test.
 - b) Detailed procedure of application of test voltage.
 - c) Measurements of RIV levels expressed in micro volts at each level.
 - d) Results and observations with regard to location and type of interference sources detected at each step.
 - e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
 - f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE – B: SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment shall be carried out alongwith supporting structure.

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

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

ANNEXURE-C: GENERAL STANDARDS AND CODES

- Indian Electricity Act - 2003
- Indian Electricity Grid Code (IEGC)
- Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007
- CEA (Technical Standards for construction, operation and maintenance of Electrical Plants and Electric Lines) Regulation, 2008
- CEA (Safety requirements for construction, operation and maintenance of transmission lines) Regulation, 2008
- CEA (Grid Standards for operation and maintenance of transmission lines) Regulation, 2006
- CEA (Safety and electricity supply) Regulation, 2008 and other applicable Laws.
- Central Board of Irrigation & Power (CBI&P): Manual on Commissioning Procedures for Transmission Line
- Central Board of Irrigation & Power (CBI&P): Manual on Maintenance of Transmission Line
- Central Board of Irrigation & Power (CBI&P): Transmission Line Manual

LIST OF SPECIFICATIONS

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	-	Insulation Coordination. P2:1983
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-60694	-	Common Specification for High Voltage

Switchgear & Controlgear Standards.

IEC-60815	-	Guide for the Selection of Insulators in respect of Polluted Conditions.
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
C36.4	-	Field Strength Instrumentation 10 KHz to 1 GHZ
ANSI-C68.1	-	Techniques for Dielectric Tests
ANSI-C76.1/IEEE21	-	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
ANSI-CG,1EEE-4	-	Standard Techniques for High Voltage Testing

CIRCUIT BREAKERS

IEC-62271-100	-	High Voltage Alternating Current Circuit Breakers
IS 13118	-	High Voltage Alternating Current Circuit Breakers
IEC-60427	-	Synthetic Testing of High Voltage alternating current circuit Breakers.
IEC-61264	-	Pressurised Hollow Column Insulators

CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS AND COUPLING CAPACITOR VOLTAGE TRANSFORMERS

IS-2705- (P1 to P4)	-	Current Transformers.
IS:3156- (P1 to P4)	-	Voltage Transformers.
IS-4379 Cylinders	-	Identification of the Contents of Industrial Gas
IEC-61869-1	-	Current transformers. IEC-
IEC 61869-2	-	Voltage Transformers.
IEC-60358	-	Coupling capacitors and capacitor dividers.
IEC-61869-4	-	Instrument Transformes : Measurement of Partial Discharges

IEC-60481	-	Coupling Devices for power Line Carrier Systems.
ANSI-C5713	-	Requirements for Instrument transformers ANSI C92.2
	-	Power Line Coupling voltage Transformers
ANSI-C93.1	-	Requirements for Power Line Carrier Coupling Capacitors
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 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-60129	-	Alternating Current Disconnectors (Isolators) and Earthing switches
IEC-1129	-	Alternating Current Earthing Switches Induced Current switching
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) 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 (Please include for Class 0.2S accuracy)
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

IEC-60068 (P1 to P5)	-	Environmental testing
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IEC-60326 (P1 to P2)	-	Printed boards Material and workmanship standards
IS-1363 (P1 to P3)	-	Hexagon headbolts, 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 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-60233	-	Tests on Hollow Insulators for use in electrical equipment.
IEC-60273	-	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.
IEC-60305	-	Insulators for overhead lines with nominal voltage above 1000V-ceramic or glass insulator units for a.c. systems Characteristics of String Insulator Units of the cap and pintype.
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
ASTM-B 231-81	-	Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221	-	Aluminum - Alloy extruded bar, rod, wire, shape
ASTM-B 236-83	-	Aluminum bars for electrical purpose (Bus-bars)
ASTM-B 317-83	-	Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)

Batteries and batteries charger

Battery

IS:1651	-	Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates)
IS:1652	-	Stationary Cells and Batteries, Lead-Acid Type (with Plante Positive Plates)
IS:1146	-	Rubber and Plastic Containers for Lead-Acid Storage Batteries
IS:6071	-	Synthetic Separators for Lead-Acid Batteries

IS:266	-	Specification for Sulphuric Acid
IS:1069	-	Specification for Water for Storage Batteries
IS:3116	-	Specification for Sealing Compound for Lead-Acid Batteries
IS:1248	-	Indicating Instruments
IEEE-485	-	Recommended practices for sizing of Lead Acid Batteries

Battery Charger

IS:3895	-	Mono-crystalline Semiconductor Rectifier Cells and Stacks
IS:4540	-	Mono-crystalline Semiconductor Rectifier Assemblies and Equipment.
IS:6619	-	Safety Code for Semiconductor Rectifier Equipment
IS:2026	-	Power Transformers
IS:2959	-	AC Contactors for Voltages not Exceeding 1000 Volts
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 controlgear.
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.
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 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 a.c. 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
BS:599	-	Methods of testing pumps
PTC-8.2	-	Power Test Codes - Centrifugal pumps

DIESEL ENGINES

IS:10000	-	Methods of tests for internal combustion engines
IS:10002	-	Specification for performance requirements for constant speed compression ignition engines for general purposes (above 20 kW)
BS:5514	-	The performance of reciprocating compression ignition (Diesel) engines, utilising liquid fuel only, for general purposes
ISO:3046	-	Reciprocating internal combustion engines performance
IS:554	-	Dimensions for pipe threads where pressure tight joints are required on threads
ASME Power Test Code	-	Internal combustion engine PTC-17
	-	Codes of Diesel Engine Manufacturer's Association, USA

PIPING VALVES & SPECIALITIES

IS:636	-	Non percolating flexible fire fighting delivery hose
IS:638	-	Sheet rubber jointing and rubber inserting jointing
IS:778	-	Gun metal gate, globe and check valves for general purpose
IS:780	-	Sluice valves for water works purposes (50 to 300 mm)
IS:901	-	Couplings, double male and double female instantaneous pattern for fire fighting
IS:902	-	Suction hose couplings for fire fighting purposes
IS:903	-	Fire hose delivery couplings branch pipe nozzles and

		nozzle spanner
IS:1538	-	Cast iron fittings for pressure pipes for water, gas and sewage
IS:1903	-	Ball valve (horizontal plunger type) including floats for water supply purposes
IS:2062	-	SP for weldable structural steel
IS:2379	-	Colour Code for the identification of pipelines
IS:2643	-	Dimensions of pipe threads for fastening purposes
IS:2685	-	Code of Practice for selection, installation and maintenance of sluice valves
IS:2906	-	Sluice valves for water-works purposes (350 to 1200 mm size)
IS:3582	-	Basket strainers for fire fighting purposes (cylindrical type)
IS:3589	-	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
IS:4038	-	Foot valves for water works purposes
IS:4927	-	Unlined flax canvas hose for fire fighting
IS:5290	-	Landing valves (internal hydrant)
IS:5312	-	Swing check type reflex (non-return) valves
(Part-I)		
IS:5306	-	Code of practice for fire extinguishing installations and equipment on premises
Part-I	-	Hydrant systems, hose reels and foam inlets
Part-II	-	Sprinkler systems
BS:5150	-	Specification for cast iron gate valves

MOTORS & ANNUNCIATION PANELS

IS:325	-	Three phase induction motors
IS:900	-	Code of practice for installation and maintenance of induction motors
IS:996	-	Single phase small AC and universal electric motors
IS:1231	-	Dimensions of three phase foot mounted induction motors
IS:2148	-	Flame proof enclosure of electrical apparatus
IS:2223	-	Dimensions of flange mounted AC induction

motors

IS:2253	-	Designations for types of construction and mounting arrangements of rotating electrical machines
IS:2254	-	Dimensions of vertical shaft motors for pumps
IS:3202	-	Code of practice for climate proofing of electrical equipment
IS:4029	-	Guide for testing three phase induction motors
IS:4691	-	Degree of protection provided by enclosure for rotating electrical machinery
IS:4722	-	Rotating electrical machines
IS:4729	-	Measurement and evaluation of vibration of rotating electrical machines
IS:5572	-	Classification of hazardous areas for electrical (Part-I) installations (Areas having gases and vapours)
IS:6362	-	Designation of methods of cooling for rotating electrical machines
IS:6381	-	Construction and testing of electrical apparatus with type of protection 'e'
IS:7816	-	Guide for testing insulation for rotating machine
IS:4064	-	Air break switches
IEC DOCUMENT 2 (Control Office) 432	-	Three Phase Induction Motor
VDE 0530 Part I/66	-	Three Phase Induction Motor
IS:9224 (Part-II)	-	HRC Fuses
IS:6875	-	Push Button and Control Switches
IS:694	-	PVC Insulated cables
IS:1248	-	Indicating instruments
IS:375	-	Auxiliary wiring & busbar markings
IS:2147	-	Degree of protection
IS:5	-	Colour Relay and timers
IS:2959	-	Contactors

PG Test Procedures

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

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 headbolts, screws and nuts of product grades A and B.
IS-1367 (P1 to P18)	-	Technical supply condition for threaded steel fasteners.
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 columbium-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
IS-269	-	33 grade ordinary portland cement.

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
ASTM-A120	-	Specification for pipe steel, black and hot dipped, zinc-coated (Galvanized) welded and seamless steel pipe for ordinary use
ASTM-A53	-	Specification for pipe, steel, black, and hot-dipped, zinc coated welded and seamless
ASTM-A106	-	Seamless carbon steel pipe for high temperature service
ASTM-A284	-	Low and intermediate tensile strength carbon- silicon steel plates for machine parts and general construction.
ASTM-A234	-	Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM-S181	-	Specification for forgings, carbon steel for general purpose piping
ASTM-A105	-	Forgings, carbon steel for piping components
ASTM-A307	-	Carbon steel externally threaded standard fasteners
ASTM-A193	-	Alloy steel and stainless steel bolting materials for high temperature service
ASTM-A345	-	Flat rolled electrical steel for magnetic applications

ASTM-A197	-	Cupola malleable iron
ANSI-B2.1	-	Pipe threads (Except dry seal)
ANSI-B16.1	-	Cast iron pipe flanges and flanged fitting. Class 25, 125, 250 and 800
ANSI-B16.1	-	Malleable iron threaded fittings, class 150 and 300
ANSI-B16.5	-	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B16.9	-	Factory-made wrought steel butt welding fittings
ANSI-B16.11	-	Forged steel fittings, socket-welding and threaded
ANSI-B16.14	-	Ferrous pipe plug, bushings and locknuts with pipe threads
ANSI-B16.25	-	Butt welding ends
ANSI-B18.1.1	-	Fire hose couplings screw thread.
ANSI-B18.2.1	-	Inch series square and hexagonal bolts and screws
ANSI-B18.2.2	-	Square and hexagonal nuts
ANSI-B18.21.1	-	Lock washers
ANSI-B18.21.2	-	Plain washers
ANSI-B31.1	-	Power piping
ANSI-B36.10	-	Welded and seamless wrought steel pipe
ANSI-B36.9	-	Stainless steel pipe

Other civil works standards

IS-269	-	33 grade ordinary portland cement.
IS-2721	-	Galvanized steel chain link fence fabric
IS-278	-	Galvanized steel barbed wire for fencing.
IS-383	-	Coarse and fine aggregates from natural sources for concrete.
IS-432 (P1 and P2)	-	Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement.
IS-456	-	Code of practice for plain and reinforced concrete. IS-
516	-	Method of test for strength of concrete.
IS-800	-	Code of practice for general construction in steel. IS-
806	-	Steel tubes for structural purposes.
IS-1172	-	Basic requirements for water supply, drainage and sanitation.
IS-1199	-	Methods of sampling and analysis of concrete. IS-

1566	-	Hard-drawn steel wire fabric for concrete reinforcement.
IS-1742	-	Code of Practice for Building drainage.
IS-1785	-	Plain hard-drawn steel wire for prestressed concrete.
IS-1786	-	High strength deformed Steel Bars and wires for concrete reinforcement.
IS-1811	-	Methods of sampling Foundry sands.
IS-1893	-	Criteria for earthquake resistant design of structures.
IS-2062	-	Steel for general structural purposes.
IS-2064	-	Selection, installation and maintenance of sanitary appliances-code of practices.
IS-2065	-	Code of practice for water supply in buildings. IS-
2090	-	High tension steel bars used in prestressed concrete.
IS-2140	-	Standard Galvanized steel wire for fencing.
IS-2470 (P1 & P2)	-	Code of practice for installation of septic tanks. IS-
2514	-	Concrete vibrating tables.
IS-2645	-	Integral cement waterproofing compounds. IS-
3025 (Part 1 to Part 48)	-	Methods of sampling and test (Physical and chemical) for water and waste water.
IS-4091	-	Code of practice for design and construction of foundations for transmission line towers and poles.
IS-4111 (Part 1 to P5)	-	Code of practice for ancillary structures in sewerage system.
IS-4990	-	Plywood for concrete shuttering work. IS-
5600	-	Sewage and drainage pumps.

National buiding code of India 1970

USBR E12	-	Earth Manual by United States Department of the interior Bureau of Reclamation
ASTM-A392-81	-	Zinc/Coated steel chain link fence fabric
ASTM-D1557-80	-	test for moisture-density relation of soils using 10- lb (4.5 kg) rammer and 18-in. (457 mm) Drop.
ASTM-D1586	-	Penetration Test and Split-Barrel

(1967)	-	Sampling of Soils
ASTM-D2049-69	-	Test Method for Relative Density of Cohesionless Soils
ASTM-D2435	-	Test method for Unconsolidated, (1982) Undrained Strengths of Cohesive Soils in Triaxial Compression.
BS-5075	-	Specification for accelerating Part I Admixtures, Retarding Admixtures and Water Reducing Admixtures.
CPWD	-	Latest CPWD specifications

ACSR MOOSE/BERSIMIS CONDUCTOR

IS:6745	Methods for Determination of Mass of zinc coating on zinc coated Iron and Steel Articles
IS:8263	Methods for Radio Interference
IEC:437-1973	Test on High Voltage Insulators NEMA:107-1964 CISPR
IS:209	Zinc Ingot BS:3436-1961
IS:398	Aluminum Conductors for IEC:209-1966
Part - V	Overhead Transmission Purposes
BS:215(Part-II)	Aluminium Conductors galvanized IEC:209-1966 steel reinforced extra high voltage (400 kV and above)
IS:1778	Reels and Drums forBS:1559-1949 Bare Conductors
IS:1521	Method for Tensile Testing ISO/R89-1959of steel wire
IS:2629	Recommended practice for Hot dip Galvanizing on Iron and Steel.
IS:2633	Method for Testing Uniformity of coating of zinc Coated Articles.
IS:4826	Hot dip galvanized coatings on round steel wiresASTMA-472-729

GALVANISED STEEL EARTHWIRE

IS:1521	Method for Tensile Testing ISO/R:89-1959 of Steel Wire
IS:1778	Reels and Drums for Bare Conductors
IS:2629	Recommended practice for Hot Dip Galvanising on Iron and Steel.
IS:2633	Methods for testing Uniformity of Coating of Zinc Coated Articles.

IS:4826	Hot dip Galvanised Coatings ASTM:A 475-72a on Round Steel Wires BS:443-1969
IS:6745	Method for Determination BS:443-1969 of mass of Zinc Coating on Zinc coated Iron and Steel Articles.
IS:209	Zinc ingot BS:3463-1961
IS:398 (Pt. I to P5:1992)	Aluminum Conductors for BS:215 (Part-II) overhead transmission purposes.

Lighting Fixtures and Accessories

IS:1913	General and safety requirements for electric lighting fittings.
IS:3528	Water proof electric lighting fittings. IS:4012 Dust proof electric lighting fittings. IS:4013 Dust tight proof electric lighting fittings.
IS:10322	Industrial lighting fittings with metal reflectors.
IS:10322	Industrial lighting fittings with plastic reflectors.
IS:2206	Well glass lighting fittings for use under ground in mines (non-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)
(7)IS:5082	Wrought aluminium and Al. alloys, bars, rods, tubes and sections for electrical purposes.
(8)IS:8623	Factory built Assemblies of Switchgear and Control Gear for voltages upto and including 1000V AC and 1200V DC.
(9)IS:1248	Direct Acting electrical indicating instruments

Electrical Installation

IS:1293	3 pin plug
IS:371	Two to three ceiling roses
IS:3854	Switches for domestic and similar purposes
IS:5216	Guide for safety procedures and practices in electrical work.
IS:732	Code of practice for electrical wiring installation (system voltage not exceeding 650 Volts.)
IS:3043	Code of practice for earthing.
IS:3646	Code of practice of interior illumination part II & III. IS:1944 Code of practice for lighting of public through fares. IS:5571 Guide for selection of electrical equipment for hazardous areas.

IS:800	Code of practice for use of structural steel in general building construction.
IS:2633	Methods of Testing uniformity of coating on zinc coated articles.
IS:6005	Code of practice for phosphating iron and steel.
LT SWITCHGEAR	
IS:8623 (Part-I)	Specification for low voltage switchgear and control gear assemblies
IS:13947 (Part-I)	Specification for low voltage switchgear and control gear, Part 1 General Rules
IS:13947 (part-2)	Specification for low voltage switchgear and control gear, Part 2 circuit breakers.
IS:13947 (part-3)	Specification for low voltage switchgear and control gear. Part 3 Switches, Disconnectors, Switch-disconnectors and fuse combination units
IS:13947 (part-4)	Specification for low voltage switchgear and control gear. Part 4 Contactors and motors starters.
IS:13947 (part-5)	Specification for low voltage switchgear and control gear. Part 5 Control-circuit devices and switching elements
IS:13947 (part-6)	Specification for low voltage switchgear and control gear. Part 6 Multiple function switching devices.
IS:13947 (part-7)	Specification for low voltage switchgear and control gear. Part 7 Ancillary equipments
IS:12063	Degree of protection provided by enclosures
IS:2705	Current Transformers
IS:3156	Voltage Transformers
IS:3231	Electrical relays for power system protection
IS:1248	Electrical indicating instruments
IS:722	AC Electricity meters
IS:5578	Guide for Marking of insulated conductors of apparatus terminals
IS:13703 (part 1)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 1 General Requirements
IS:13703 (part 2)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 2 Fuses for use of authorized persons
IS:6005	Code of practice of phosphating iron and steel
IS:5082	Wrought Aluminum and Aluminum alloys for electrical purposes
IS:2633	Hot dip galvanizing

TECHNICAL DATA REQUIREMENTS

CONTENTS

Sl. No.	Item
1.	Power Transformers
2.	Shunt reactor
3.	Circuit Breakers
4.	Current Transformers
5.	Capacitive Voltage Transformers
6.	Isolators/ Grounding Switches
7.	Surge Arresters
8.	LT Transformer
9.	1.1 KV Power & Control cables
10.	LT Switchgear
11.	Lighting System
12.	Battery & Battery Charger
13.	Disc Insulator, Insulators, Conductor, GS Wire & Marshalling Kiosk
14.	Air Conditioning System
15.	Fire Protection System
16.	Control & Relay Panels
17.	BCU
18.	PLCC
19.	48V Battery
20.	DG Set

POWER TRANSFORMERS:

Sl. No.	Details			
A	DATA SHEETS - TRANSFORMER			
1	Manufacturer's Name and Address			
2	Rating (MVA)			
3	Voltage ratio (kV)			
4	a) Winding Connection			
	b) Number of windings			
5	Vector Group			
6	Number of Phases			
7	Frequency(Hz)			
8	Type of cooling			
9	Rating available at different cooling (%) (60%, 80%, 100%)			
10	Current at rated voltage and on principal tap – HV			
	IV			
	LV			
11	Impedance data	Principal Tap	Maximum Tap	Minimum Tap
	a) Positive sequence impedance between HV-MV at 75 deg. C with 100% rating at.			
	b) HV - LV impedance			
	c) MV-LV impedance			
	d) Zero sequence impedance at principal tap			
11 (a)	Magnetisation data at no load, at rated frequency and at rated voltage (along with tolerance if any)			
	a. Current in Amps			
	b. Power factor			
	c. Loss in KW (core loss + dielectric loss)			
	d. Max. flux density in lines/sq.cm.			
(b)	Load loss including cooler loss, at principal tap, at rated frequency, at rated voltage, at rated current, at 75°C			

	a. For ONAN rating CuL. in KW			
	b. For ONAF rating CuL. in KW+CL in KW			
	c. For OFAF rating CuL. in KW+CL in KW			
	NOTE : 1. CuL : Copper loss			
	2. CL : Cooler loss			
	Note for Sl. No. 11(a) and (b) - Guaranteed values of losses shall be indicated which shall be firm and with out indicating the tolerance limit			
	Note:Please Refer clause No. 12.0, Guaranteed Losses of the Technical specifications for Auto Transformer.			
12	Guaranteed cooler losses at			
	a) 100% load (kW).			
	b) 80% load (kW)			
	c) 60% load (kW)			
13	Cooling Equipment Details			
	a) Number of coolers and rating as % of transformer cooling equipment.			
	b) Mounting			
	c) Fan Motor data			
	i) Number per cooler and rating as % of cooler requirment (Also indicate no. of spare fans).			
	ii)Type			
	iii)Rating(kW)			
	iv) Locked rotor current (Amps)			
	v) Temp. range over which cooler control is adjustable (deg.C to deg. C)			
	vi) Rated Power (KW)			
	vii) Capacity (cu m/min) or (Litres/Minute)			
	viii) Rated voltage (Volts)			
	ix) Efficiency of motor at full load (percent)			
	x) Temp. rise of motor at full load (°C)			
	xi) Whether the fan and/or pumps suitable for continuous operation at 85% of their rated votlage			
	xii) Estimated time constant in hours for			
	a) Natural cooling			

	b) Forced air cooling			
	d) Oil Pump Motor data			
	i) Number per cooler and rating as % of cooler requirement (Also indicate no. of spare pumps).			
	ii) Type			
	iii) Rating (kW)			
	iv) Locked rotor current (Amps)			
	v) Temp. range over which cooler control is adjustable (deg.C to deg. C)			
	vi) Rated Power (KW)			
	vii) Capacity (cu m/min) or (Litres/Minute)			
	viii) Rated voltage (Volts)			
	ix) Efficiency of motor at full load (percent)			
	x) Temp. rise of motor at full load (°C)			
	xi) Whether the fan and/or pumps suitable for continuous operation at 85% of their rated voltage			
	xii) Estimated time constant in hours for			
	a) Natural cooling			
	b) Forced air cooling			
	e) Type of oil Pump and motor (Whether oil submerged type)			
	f) Radiator details			
	i) Overall dimensions lxbxh (mm)			
	ii) Total weight with oil (kg)			
	iii) Total weight without oil (kg)			
	iv) Thickness of Radiator tube (mm)			
	v) Type of mounting			
14	Thermal Data			
	a) Temperature rise in top oil over an ambient of 50 deg. C. (deg. C)			
	b) Temperature rise in winding by resistance measurement method over an ambient of 50 deg.C			
	c) Thermal time constant (Hours)			
	d) Maximum hot spot temperature rise calculated by formula deg. C			

	e) Period of operation of transformer at full load without calculated winding hot spot temperature exceeding 140 deg. C and when			
	(a) 50% coolers fail			
	(b) 100% coolers (Refer Cl. No. 7.9) fail			
15	a) Short time thermal rating of LV winding/tertiary winding in KA & duration in seconds.			
	b) Short time thermal rating of IV winding in KA & duration in seconds.			
	c) Short time thermal rating of HV winding in KA & duration in seconds.			
16	Over excitation withstand time (secs.)			
	i) 125%			
	ii) 140%			
	iii) 150%			
	iv) 170 %			
17	Efficiency at 75°C as derived from guaranteed loss figures	At unit p.f.	At 0.8 p.f.	
	a. At 125% full load			
	b. At 100% full load			
	c. At 75% full load			
	d. At 50% full load			
18	a. Maximum efficiency%			
	b. Load at which maximum efficiency occurs (% of full load)			
19	Regulation at full load and at 75°C			
	a. At unity p.f. in %			
	b. At 0.8 p.f. (lag) in %			
20	Partial discharge level at Um			
21	Bushings			
a)	High Voltage			
	i) Manufacturer			
	ii) Type			
	iii) Total creepage distance (mm)			
	iv) Protected creepage distance (mm)			
	vi) Mounting			

	vi) Rated current(Amps)			
	vii) Rated voltage - KV			
	viii) Quantity of oil in bushing and specification of oil used (Kgs)			
	ix) Whether test tap is provided.			
	x) Weight of assembled bushing			
	xi) Phase to earth clearance in air of live parts at the top of bushing			
b)	Medium Voltage			
	i) Manufacturer			
	ii) Type			
	iii) Total creepage distance (mm)			
	iv) Protected creepage distance(mm)			
	vi) Mounting			
	vi) Rated current(Amps)			
	vii) Rated voltage - KV			
	viii) Quantity of oil in bushing and specification of oil used (Kgs)			
	ix) Whether test tap is provided.			
	x) Weight of assembled bushing			
	xi) Phase to earth clearance in air of live parts at the top of bushing			
c)	Low Voltage			
	i) Manufacturer			
	ii) Type			
	iii) Total creepage distance (mm)			
	iv) Protected creepage distance(mm)			
	vi) Mounting			
	vi) Rated current(Amps)			
	vii) Rated voltage - KV			
	viii) Quantity of oil in bushing and specification of oil used (Kgs)			
	ix) Whether test tap is provided.			

	x) Weight of assembled bushing			
	xi) Phase to earth clearance in air of live parts at the top of bushing			
22	Proposed method of transformer transportation			
23	Is vacuum filing required? If so, state absolute pressure (mm of HG)			
24	Total quantity of oil(litres)			
25	Tap changing equipment rating			
	a) Voltage class and current			
	b) Number of steps			
	c) Range			
	d) Step voltage			
	e) Type			
	f) Rated voltage of driver motor (Volts)			
	g) No. of revolutions to complete one step			
	h) Time to complete one step on manual/auto operation (Secs.)			
	i) Power required (kW)			
	j) Power flow (uni-directional or bi-directional or restricted bi-directional)			
	k) Control : Manual / Auto / Local / Remote / Independent / Parallel.			
	l) Auxiliary supply details			
	m) Voltage control (whether automatic or manual)			
	n) Line drop compensation Provided / Not provided.			
	o) Protective devices			
	p) Divertor selector switch Transient time - Cycles.			
	q) Value of maximum short circuit current Amps.			
	r) Maximum impulse withstand test voltage with 1.2/50 micro seconds full wave between switch assembly and earth (kV peak)			
	s) Maximum power frequency test voltage between switch assembly and earth - kV rms.			

	t) Maximum impulse withstand test voltage with 1.2/50 micro seconds across the tapping range (kV peak).			
	u) Approximate over all dimensions of Tap changer mm			
	v) Approximate over all weight Kgs.			
	w) Approximate over all quantity of oil-ltrs/Kgs.			
	x) Particulars of the OLTC control panel for installation in the control room.			
26	Insulation Level			
	a) HV Winding			
	i) Lightning impulse withstand voltage (kVp)			
	ii) Switching Surge withstand voltage (kVp)			
	ii) Power Frequency withstand voltage (kV rms)			
	b) MV Winding			
	i) Lightning impulse withstand voltage (kVp)			
	ii) Power Frequency withstand voltage (kV rms)			
	c) LV Winding			
	i) Lightning impulse withstand voltage (kVp)			
	ii) Power Frequency withstand voltage (kV rms)			
	d) HV Bushings			
	i) Lightning impluse withstand voltage (kVp)			
	ii) Switching Surge withstand voltage (kVp)			
	iii) Power Frequency withstand voltage (kV rms)			
	e) MV Bushings			
	i) Lightning impulse withstand voltage (kVp)			
	ii) Power Frequency withstand voltage (kV rms)			
	f) LV Bushings			
	i) Lightning impulse withstand voltage (kVp)			
	ii) Power Frequency withstand voltage (kV rms)			
	g) Neutral Bushings			
	i) Lightning impulse withstand voltage (kVp)			
	ii) Power Frequency withstand voltage (kV rms)			

27	Approximate diemensions			
	a) Tank (1xbxh) (mm)			
	b) Overall dimensions with coolers (1xbxh) (mm)			
	c) Shipping dimensions (1xbxh) (mm)			
	d) Hieght for un-tanking (mm)			
	e) Dimensons of largest package (1xbxh) (mm)			
28	Weights of Transformer Components			
	a) Core (kg)			
	ii) Windings(kg)			
	iii) Insulation (kg)			
	d) Tank and fittings (kg)			
	e) Oil (kg)			
	f) Untanking weight (heaviest piece) (kg)			
	g) Total weight (kg)			
	h) Weight of heaviest package (kg)			
	i)Total shipping weight (kg)			
	j) Parts detached for transport (furnish list)			
29	Permissible overload (% of rating and time in minutes)			
30	Clearances			
	a) Minimum clearance between phases			
	i) In oil (mm)			
	ii)In air(mm)			
	b) Minimum clearance of HV winding to tank in oil (mm)			
	c) Minimum clearance of HV winding to earth in oil (mm)			
	d) Clearance between Core and Coil (mm)			
	e) Clearance between coils (mm)			
	f) Clearance between neutral to ground in air (mm)			
31	Conservator	For Tr. tank	OLTC	
	a) Total volume (Litres)			

	b) Volume between highest and lowest levels (Litres)			
	c) No. of Breathers provided (No.)			
	d) Type of dehydrating agent used for breathers			
32	Valve sizes and number required/ fitted			
	i. Drain valves - mm - No.			
	ii. Filter valves - mm - No.			
	iii. Sampling valves - mm - No.			
33	Capacitance Values			
a)	HV to earth (pF)			
b)	MV to earth (pF)			
c)	LV to earth (pF)			
34.a)	Type of oil preservation			
b)	Material of air cell			
c)	Continuous temp. withstand capability of the air cell			
35. a)	Type and Make of pressure relief /device			
b)	No. of pressure relief device provided			
c)	Operating pressure of pressure relief device			
36	Lifting Jacks (Hydraulic jacks)			
a)	Governing standard			
b)	Number of jacks in one set			
c)	Type and Make			
d)	Capacity (Tonnes)			
e)	Pitch(mm)			
f)	Lift (mm)			
g)	Height in closed position (mm)			
h)	Mean diameter of thread (mm)			
37	Oil			
a)	Characteristics of Insulating oil to be used			
	1 - Function			
	Viscosity at 40 °C in mm ² /s			

	Viscosity at -30 °C in mm ² /s			
	Pour point in °C			
	Water content in mg/kg			
	Breakdown voltage in kV			
	Density at 20 °C in g/ml			
	DDF at 90 °C			
	Particle content			
	2 – Refining/stability			
	Appearance			
	Acidity in mg KOH/g			
	Interfacial tension in mN/m			
	Total sulphur content			
	Corrosive sulphur			
	Potentially corrosive sulphur			
	DBDS in mg/kg			
	Inhibitors of IEC 60666 in %			
	Metal passivator additives of IEC 60666 in mg/kg			
	Other additives			
	3- Furfural and related compounds content in mg/kg			
	Stray gassing			
	4 - Performance			
	Oxidation stability for uninhibited oil – 164 hrs			
	-Total acidity in mg KOH/g			
	-Sludge in %			
	-DDF at 90 °C			
	Gassing tendency			
	ECT			
	5 – Health, safety and environment (HSE)			
	Flash point in °C			
	PCA content in %			

	PCB content in mg/kg			
	6 – Carbon Composition FTIR method			
	CA %			
	CN %			
	CP %			
b)	Quantity of oil (liters) as per clause no 6.4(b), Sec- Auto-Transformer."Sufficient quantity of oil necessary for first filling of all tanks, coolers and radiator at the proper level along with 10% extra oil for topping up shall be supplied in non-returnable containers suitable for outdoor storage.			
c)	Standards applicable			
38	Core			
a)	Type of construction (core/Shell)			
b)	Net core area (mm ²)			
c)	Core material and grade used			
d)	Type of joint between core and yoke			
e)	Thickness of stamping (mm)			
f)	Percentage silicon content (%)			
g)	Maximum flux density in core at rated frequency			
	i) 90% voltage (wb/sq.m)			
	i) 100% voltage (wb/sq.m)			
	i) 110% voltage (wb/sq.m)			
39	Winding			
	The Contractor shall ensure that windings of 400kV class transformers are made in dust proof and conditioned atmosphere. The Bidder shall furnish the details of the facilities available in this regard at their works. Please enclose necessary documentation in proof of the above.			
a)	Type of winding			
b)	Current density at rated load			
	i) HV (A/sq.mm)			
	ii) MV (A/sq.mm)			

	iii) LV (A/sq.mm)			
c)	Conductor area			
	i) HV (sq.mm)			
	ii) MV (sq.mm)			
	iii) LV (sq.mm)			
d)	Maximum current density under short circuit			
	i) HV (A/sq.mm)			
	ii) MV (A/sq.mm)			
	iii) LV (A/sq.mm)			
e)	Magnetizing inrush current (Amps)			
f)	No load Current (Amps) at rated frequency			
	a) 90% Voltage (A)			
	b) 100% Voltage (A)			
	c) 110% Voltage (A)			
g)	Magnetizing current at rated frequency and at rated voltage			
h)	1) Leakage reactance			
	i) HV (Ohms)			
	ii) MV (Ohms)			
	iii) LV (Ohms)			
	2) Leakage resistance			
	i) HV (Ohms)			
	ii) MV (Ohms)			
	iii) LV (Ohms)			
i)	Winding insulation	Type and class	Graded and ungraded	
	HV			
	IV			
	LV			
j)	i. Insulating material used for :			
	1. Regulating winding			
	2. HV winding			
	3. IV winding			

	4. LV winding			
	ii. Between HV and IV and LV as applicable			
	iii. Between core & LV side.			
	iv. For core bolts, washers and end plates			
	v. Regulating winding & earth.			
k)	i. Type of axial coil support			
	HV winding			
	IV winding			
	LV winding			
	ii. Type of Radial coil support :			
	HV winding			
	IV winding			
	LV winding			
l)	Core bolt insulation voltage			
m)	Details of special arrangement provided to improve surge voltage distribution in the windings			
40	Tank			
a)	Tank cover -Conventional/Bell Type			
b)	Material			
c)	Approximate thickness of			
	i) Sides (mm)			
	ii) Bottom (mm)			
	iii) Cover (mm)			
41	Radiator			
a)	Make			
b)	Material			
c)	Thickness (mm)			
d)	Total radiating surface in square meters			
e)	Method of drying out transformer at site			
f)	Type of radiator			
g)	Total number of Radiators/Banks for transformer and over all dimensions.			
h)	Rating of Transformer with one radiator bank out of service.			
i)	Vacuum withstand capability			

42	Vacuum withstand capability of			
a)	Main Tank (torr)			
b)	Radiators and accessories(torr)			
c)	Vacuum recommended for hot oil circulation (torr)			
d)	Vacuum to be maintained during oil filling in transformer tank (torr)			
43	Pressure withstand capability of			
a)	Main Tank (torr)			
b)	Radiators and accessories(torr)			
44	Gasket			
a)	Material			
b)	Temperature withstand capability (° C)			
45	Noise level when energized at normal voltage and normal frequency at no load (db)			
46	Minimum draw bar pull required to move the transformer on level track (kg)			
47	Size of filter hose (mm)			
48	Temperature Indicators			
a)	OTI			
	i) Manufacturer			
	ii) Range			
	iii) Accuracy			
	iv) No. of contacts			
	v) Current rating of each contact			
	vi) Size and No.			
b)	WTI			
	i) Manufacturer			
	ii) Range			
	iii) Accuracy			
	iv) No. of contacts			
	v) Current rating of each contact			
	vi) Size and No.			
c)	RWTI			
	i) Manufacturer			
	ii) Range			

	iii) Accuracy			
	iv) Auxiliary supply used			
d)	ROTI			
	i) Manufacturer			
	ii) Range			
	iii) Accuracy			
	iv) Auxiliary supply used			
49	Ratio and Type of CT used for winding temperature			
	a. Ratio			
	b. Type			
50	Type of oil level indicator and whether supervisory alarm contact for low oil level provided (Yes/No)			
51	Type and size of Gas operated relay and whether supervisory alarm and trip contacts provided and their size and Nos.			
52 i)	No. & size of bi-directional wheels provided.			
ii)	Track gauge required for the wheels			
53	Details of painting at works and site			
54	Compliance to technical specification with respect to			
	(i) Microprocessor based numerical RTCC unit (ITCS) Yes/No			
	(ii) On line dissolved gas (multi gas) and moisture analyser Yes/No			
	(iii) Fibre optic temperature monitoring system Yes/No			
	(iv) On line insulating oil drying system (cartridge Type) Yes/No			
B	DATA SHEETS - BUSHING CURRENT TRANSFORMER			
1)	Bushing Current Transformer on Auto Transformer			
a)	HV Side	Core 1	Core 2	
	i) Type or voltage class			
	ii) Ratio			
	iii) Accuracy Class			
	iv) Burden(VA)			
	v) Accuracy limit factor			

	vi) Knee point voltage (Volts) (minimum)			
	vii) Maximum resistance of secondary winding (ohms)			
	viii) Maximum exciting (mA) current			
b)	MV side			
	i) Type or voltage class			
	ii) Ratio			
	iii) Accuracy Class			
	iv) Burden(VA)			
	v) Accuracy limit factor			
	vi) Knee point voltage (Volts) (minimum)			
	vii) Maximum resistance of secondary winding (ohms)			
	viii) Maximum exciting (mA) current			
c)	LV side:			
	i) Type or voltage class			
	ii) Ratio			
	iii) Accuracy Class			
	iv) Burden(VA)			
	v) Accuracy limit factor			
	vi) Knee point voltage (Volts) (minimum)			
	vii) Maximum resistance of secondary winding (ohms)			
	viii) Maximum exciting (mA) current			
d)	Neutral side			
	i) Type or voltage class			
	ii) Ratio			
	iii) Accuracy Class			
	iv) Burden(VA)			
	v) Accuracy limit factor			
	vi) Knee point voltage (Volts) (minimum)			
	vii) Maximum resistance of secondary winding (ohms)			
	viii) Maximum exciting (mA) current			

SHUNT REACTORS

Sr. No.	Description	Unit	Bidder Details
			Data Sheet B
A.	<u>SHUNT REACTOR:</u>		
1	Maker's Name		
2	Governing Standard		
3	Type of reactor		
4	Type of cooling		
5	Connection		
6	a) Reactive power for continuous operation		
	I) At rated voltage	(MVAR)	
	II) At highest voltage (i.e. 5% higher than rated)	(MVAR)	
	b) Rated voltage	kV	
	c) Temperature rise in oil above ambient temp.	°C	
	d) Temperature rise of winding by resistance above ambient temperature	°C	
	e) Rated frequency	(Hz)	
7	Number of Phases		
8	a) Guaranteed losses at rated voltage and frequency at rated output and at 75°C average winding temperature	(KW)	
	b) Tolerance on above losses	(%)	
9	Guaranteed max. losses at rated voltage and frequency at rated output at its percentage		
10	Impedance :		
	a) Positive sequence	(Ohms)	
	b) Zero sequence	(Ohms)	
11	Ratio of reactor (i.e. Q-factor)		
12	Maximum permissible duration of service at 110% of rated voltage, starting from cold without exceeding permissible temperature rise	(hrs.)	
13	Noise level and reference standard	(db).	
14	Test voltage (for winding)		
	a) Lightning impulse (1.2/50 micro-seconds) withstand voltage	(KV peak)	
	b) Power frequency withstand voltage	(KV rms.)	
	c) Switching surge withstand voltage	(KV peak)	
15	Clearances:		

	a) HV phase to Phase	(mm)	
	b) Phase to Ground	(mm)	
	c) Neutral to Ground	(mm)	
16	Approximate weights (kgs.)		
	a. Core	(kgs.)	
	b. Winding	(kgs.)	
	c. Tank and fittings	(kgs.)	
	d. Oil	(kgs.)	
	e. Total weight	(kgs.)	
	f. Untanking weight	(kgs.)	
	(to provide access to core and coils)		
17	Quantity of oil (including 10% extra)	liters.	
18	Conservator		
	a) Total volume		
	b) Volume between highest and lowest visible oil levels.		
19	(a) Size of largest package	(mm x mm x mm)	
	(b) Weight of largest package (kgs.)		
	(c) Gross weight to be handled (kgs.)		
	(d) Gross volume to be handled (M3)		
20	Bushing as per IS : 2099		
	a) Type		
	b) Maker's name and country of Manufacturer		
	c) Momentary power Frequency withstand voltage		
	d) One minute power frequency withstanding voltage		
	1) Dry	(KV)	
	2) Wet	(KV)	
	e) Power Frequency puncture voltage		
	f) Full wave impulse withstand voltage	(KV)	
	g) Impulse puncture voltage	(KV)	
	h) Total creepage distance in air	mm	
	i) Weight and dimensions of assembled Bushings.	Kg	
21	Core		
	a) Type of core		
	b) Justification for type of core adopted		
	c) Technical details of the core		

	i) Material		
	ii) Thickness	mm	
	iii) Grade (Prime only)		
	iv) Insulation of core lamination		
	v) Press board material and thickness		
22	Zero Sequence Reactance/ positive sequence reactance i.e. X0/XL		
23	Range of voltage up to which impedance will be constant and magnetization curve up to 2.5 pu. Voltage.		
24	Vibration level		
25	Amount of unbalanced current in each phase when connected to symmetrical voltages.		
26	Lifting jacks (mechanical screw jacks)		
	a) Governing standards		
	b) Number of Jacks included in one set.		
	c) Type and make.		
	d) Capacity		
	e) Pitch		
	f) Lift		
	g) Mean diameter of thread		
27	Capacitance value (Phase to Ground)		
28	Type of oil preservation system		
29	Harmonic content in Phase current		
30	Quality of oil (please enclose separate sheet for characteristics of oil)		
31	Cooling calculation shall be submitted		
B	NEUTRAL GROUNDING REACTOR:		
1 (i)	Rated voltage from insulation strength considerations		
(ii)	Rated frequency		
(iii)	No of phases		
(iv)	Type		
(v)	Insulation		
(vi)	Max. continuous current	Amps	
(vii)	Rated short time current (10 sec)	Amps	
(viii)	Rated impedance at rated short time current		
2	Bushings		
(i)	Rated voltage		
(ii)	Creepage distance (total)	mm	
(iii)	Mounting		
(iv)	Lightning Impulse (1.2/50 micro sec) withstand voltage	(kVp)	
(v)	Power Frequency withstand voltage	(kV rms)	
3	Insulation level for winding	Line side/ groundside	
(i)	Lightning Impulse (1.2/50 micro sec) withstand voltage	kVp	

(ii)	Power Frequency withstand voltage	kVrms	
(iii)	Max. admissible temperature rise over ambient temperature of 50°C at rated voltage		
	a) of winding measured by resistance	°C	
	b) of top oil measured by thermometer	°C	
(iv)	Cooling system		
(v)	Cooling medium		
(vi)	Whether neutral is to be brought out		
(vii)	Method of grounding		

C. SURGE ARRESTERS:

1	Name and address of Manufacturer:		
2	Manufacturer's type designation:		
3	Applicable standards :		
4	Arrester class and type :		
5	Rated arrester voltage	(kV) :	
6	Rated system voltage	(kV) :	
7	Maximum continuous operating voltage (COV) at 50 deg.C ambient temperature	(kV)	
8	Nominal discharge current(8/20 micro sec.wave)	(kA)	
9	Minimum discharge capability	(kJ / kV) :	
	a) Maximum residual voltage at nominal discharge current	(kVpeak)	
	b) Minimum residual voltage at nominal discharge current	(kVpeak)	
10	a) Maximum residual voltage at 50 % nominal discharge current	(kVpeak)	
	b) Maximum residual voltage at 200% nominal discharge current	(kVpeak)	
11	Steep fronted wave residual voltage at 1 KA	(kVpeak)	
12	Maximum switching surge impulse residual voltage at 1 KA	(kVpeak)	
13	Long duration discharge class :		
14	Impulse current withstand		
	a) High current short duration (4/10 micro-sec wave)	(kVpeak)	
	b) Low current long duration : (2000 microsec.)	Amps	
15	Current for pressure relief test	(kA) :	
16	Pressure relief class (as per IEC 99) :		
17	One minute power frequency (dry) withstand voltage of arrester housing	(kVrms)	
18	Lightning Impulse withstand test voltage of arrester housing with 1.2/50 microsec wave	(kVp)	
19	Switching Surge Impulse withstand test voltage of arrester housing with 250/2500 microsec wave	(kVp)	
20	Total creepage distance of whole arrester housing	(mm):	
21	Cantilever strength of complete arrester	(N) :	
22	Total height of the arrestor (mm) :	(mm):	
23	Total weight of the arrestor	(Kg) :	

24	Maximum radio interference voltage at 1.1 Ur / $\sqrt{3}$ voltage at 1 MHz	(microvolts)	
25	Partial discharge at 1.05 continuous operating voltage	(pC)	
26	Minimum prospective symmetrical fault current :	(kArms)	
27	Compliance to technical specification w.r.t :		
	i) Surge monitor	YES / NO	
	ii) Support Insulator	YES / NO	
	iii) Terminal connectors	YES / NO	
28	ZnO block details :		
	a) Make and size of ZnO block :		
	b) Whether equipment type tested with offered type of ZnO block	: YES / NO	
29	Whether similar equipment are type tested as per IEC/IS or equivalent standard and are in successful operation for at least two years	: YES / NO	
30	Overall General Arrangement drawing of Surge arrester is to enclosed.	: YES / NO	

CIRCUIT BREAKER

SL. NO.	DETAILS	UNIT	
1	MANUFACTURER'S NAME AND COUNTRY OF MANUFACTURE		
2	MANUFACTURER'S TYPE AND DESIGNATION		
3	APPLICABLE STANDARDS		
4	APPLICATION		
5	QUANTITY	no.	
6	TYPE OF CIRCUIT BREAKER		
7	EXECUTION OF POLES (ONE 3 PHASE ON COMMON BASE OR THREE 1 PHASE)		
8	VOLTAGE AND FREQUENCY	kV & Hz	
9	POWER FREQUENCY WITHSTAND VOLTAGE	kV (rms)	
10	LIGHTNING IMPULSE WITHSTAND VOLTAGE	kVp	
11	SWITCHING IMPULSE WITHSTAND VOLTAGE	kVp	
11.1	Dielectric withstand voltage of Complete Breaker		
12	Rated continuous current at design temp. of 50 deg.C	A	
12.1	Rated terminal load	A	
13	SHORT CIRCUIT BREAKING CURRENT	kA (rms)	
13.1	Symmetrical component at highest system voltage (kA)		
13.2	DC Component (%) for DC Time constant of 60ms		
13.3	Asymmetrical breaking current at highest system voltage (kA)		
14	SHORT TIME WITHSTAND CURRENT AND DURATION	kA (rms), Sec	
15	MAKING CAPACITY		
15.1	At Higher rated voltage	kA (peak)	
15.2	At Lower rated voltage	kA (peak)	
16	OUT OF PHASE BREAKING CURRENT CAPACITY	kA (rms)	
17	AUTO RECLOSING (1 POLE/ 3 POLE) (REQUIRED)	Yes/No	
18	OPERATING DUTY		
19	FIRST POLE TO CLEAR FACTOR (1.3/1.5)		
20	MAXIMUM TEMPERATURE RISE OF CONTACTS OVER AMBIENT FOR RATED CURRENT.	°C	
21	TEMPERATURE RISE OVER THE DESIGN AMBIENT TEMPERATURE		
22	ADDITIONAL RATINGS		
22.1	LINE CHARGING BREAKING CURRENT (The breaker shall be able to interrupt rated line charging current with test voltage immediately before opening equal to the prout of $U/\sqrt{3}$ and 1.4 as per IEC 62271-100.	A	
22.2	CABLE CHARGING BREAKING CURRENT	A	

22.3	CAPACITOR BREAKING CURRENT	A	
22.4	SMALL INDUCTIVE BREAKING CURRENT	A	
22.5	OUT OF PHASE SWITCHING (REQUIRED)	Yes/No	
23	OPERATING MECHANISM TYPE		
23.1	For opening		
23.2	For closing		
23.3	If pneumatic, air pressure for operation and lockout	(kg/sq.cm)	
23.4	If Hydraulic, pressure for operation and lockout	(kg/sq.cm)	
23.5	Capacity of the local air receiver and time required for charging	(cu.m/sec)	
23.6	Capacity of the pressure receiver and time required for charging	(cu.m/sec)	
24	1 POLE//3 POLE OPERATION		
25	CONTROL VOLTAGE (DC/ AC)		
25.1	MOTOR (DC/ AC)		
25.2	CLOSE/TRIP COILS/CIRCUIT		
26.1	TOTAL BREAK TIME(CONSIDERING TOLERANCES IN STANDARD)	ms	
26.2	Rated Break time (As per IEC)	ms	
26.3	CLOSING TIME	ms	
26.4	ARCING TIME	ms	
26.5	Maximum Opening time with limiting voltages and pressures (considering all conditions)		
26.6	Maximum Close open time with limiting voltages and pressures (considering all conditions)		
26.7	Total Closing Time	ms	
27	Rated Transient Recovery Voltage as per IEC 62271-100 (Table no. 5) for		
27.1	Terminal Faults	kV (peak)	
27.2	Short-Line Faults	kV (peak)	
27.3	Out of phase	kV (peak)	
28	Recovery voltage distribution between breaks as percentage of rated voltage, if more than one break per pole		
28.1	Single line to ground fault	kV (peak)	
28.2	Interruption on short lines	kV (peak)	
28.3	Switching off unloaded transformer	kV (peak)	
29.1	No. of Breaks in Series per Pole	Nos.	
29.2	Type of Device, If any, Used to obtain uniform Voltage distribution between breaks		
30	MINIMUM CLEARANCES IN AIR		
30.1	BETWEEN PHASES (LIVE PARTS)	mm	
30.2	BETWEEN LIVE PARTS AND EARTH	mm	
30.3	BETWEEN LIVE PARTS TO GROUND LEVEL	mm	
31	INSULATORS		

31.1	Make		
31.2	Weight		
31.3	Transport dimensions		
31.4	Height above floor required to remove bushings (mm)		
31.5	Insulation class		
31.6	Flashover voltage (kV)		
31.7	Nature of the dielectric medium employed in the bushings		
31.8	Permissible safe cantilever loading on installed bushing (kg)		
32	Compliance to technical specification w.r.t. Parameters specified for		
32.1	Control Cabinet		
32.2	Bushing/ Support insulators		
32.3	Terminal connectors		
32.4	SF6 gas		
32.5	Whether monitor for SF6 gas provided.		
32.6	Leakage of SF6 gas permissible (/24 hours.)		
32.7	Leakage of air permissible (/24 hours.)		
33	PHASE TO PHASE SPACING (3 PH – UNIT)	mm	
34	PICK-UP RANGE OF TRIP COILS	%	
35	POWER REQUIRED FOR TRIPPING MECHANISM (PER TRIP COIL) –	Watts	
35.1	STEADY STATE		
35.2	TRANSIENT		
36	a) TYPE OF MOTOR & RATED VOLTAGE	Volts	
	b) POWER REQUIRED FOR THE MOTOR	Watts	
	c) POWER REQUIRED FOR THE CLOSING MECHANISM	Watts	
37	CRITICAL CURRENT (CURRENT GIVING LONGEST ARC DURING A BREAK)	A	
38	MAXIMUM OVERVOLTAGE TO EARTH WHEN BREAKING CURRENT OF		
38.1	UNLOADED TRANSFORMER	kV (peak)	
38.2	UNLOADED LINE	kV (peak)	
38.3	CAPACITOR BANK	kV (peak)	
38.4	CABLE CHARGING	kV (peak)	
38.5	Under any switching condition		
39	WHEN SWITCHING OFF ASYNCHRONOUS SYSTEM		
39.1	MAXIMUM CURRENT	kA	
39.2	MAXIMUM RECOVERY VOLTAGE BETWEEN CONTACTS OF ONE POLE	kV (peak)	
40	FURNISHED MAINTENANCE CURVE, CURRENT/ No. OF OPERATIONS FOR THE OFFERED CIRCUIT BREAKER.	Yes/No	

41	QUANTITY OF SF6 IN EACH INTERRUPTER	Lt./Kg	
42	LINKING MECHANISM FOR 1 POLE UNITS		
	a) ELECTRICAL		
	b) MECHANICAL		
	c) PNEUMATIC		
	d) HYDRAULIC		
	e) ANY OTHER		
43	WEIGHT OF COMPLETE 3 PHASE BREAKER	Kg	
44	DIMENSIONAL DRAWING OF CIRCUIT BREAKER WITH STRUCTURE ENCLOSED	Yes/No	
45	WHETHER TYPE TEST REPORTS ARE AS PER THE LATEST STANDARDS ENCLOSED AND IN SUCCESSFUL OPERATION FOR ATLEAST 2 YEARS ?	Yes/No	
46	WHETHER ALL ROUTINE/TYPE/ ACCEPTANCE TESTS AS SPECIFIED WILL BE CARRIED OUT ON EACH CIRCUIT BREAKER (IF NOT, FURNISH LIST)	Yes/No	
47	a) WHETHER SHORT CIRCUIT TEST CERTIFICATE ENCLOSED	Yes/No	
	b) WHETHER OSCILLOGRAM ENCLOSED	Yes/No	
48	WHETHER LITERATURE GIVING DETAILS OF ARCING CHAMBER AND MAN & ARCING CONTACTS ENCLOSED	Yes/No	
49	Furnish data on capabilities of circuit breaaer in terms of time and number of operations at duties ranging from 100 % fault currents to load currents of the lowest possible value without requiring any maintenance or checks	Yes/No	
50	Furnish details of effect of non simultaneity between contacts within a pole or between poles and also show how it is covered in the guaranteed rated break time.	Yes/No	
51	Overall General Arrangement drawing of circuit breaker is to be enclosed	Yes/No	
52	RADIO FREQUENCY INTERFERENCE VOLTAGE	mV	
53.1	AUX CONTACTS (NO & NC)	nos.	
53.2	No of Terminals in common Control cabinet	nos.	
54	NO. OF TRIP COILS PER POLE	nos.	
55	PURCHASER'S EARTHING CONDUCTOR (MATERIAL AND SIZE)	mm x mm	
56	WHETHER MOUNTING STRUCTURE INCLUDED IN VENDOR'S SCOPE OF SUPPLY	yes/no	
57	CLAMPS AND CONNECTORS		
	a) BY PURCHASER/VENDOR		
	b) TAKE-OFF (HORIZ./VERT./OTHER)		
	c) CONDUCTOR MATERIAL & SIZE		
58	TYPE OF TANK (LIVE/ DEAD)		
59.1	MAXIMUM PERIOD BETWEEN CLOSING OF FIRST CONTACT AND LAST CONTACT IN A POLE	ms	
59.2	Maximum pole discrepancy	ms	

60	Maximum difference in the instance of closing/ opening of contacts		
60.1	Within a pole	ms	
60.2	Between poles opening	ms	
60.3	Between poles closing	ms	
61	SMALL FAULT CURRENT BREAKING CAPACITY	Amps	
62	RATED PRESSURE AND LIMITS OF PRESSURE EXTINGUISHING MEDIUM	kg/ sq.cm	
63	MINIMUM DEAD TIME FOR		
63.1	THREE PHASE RECLOSING	ms	
63.2	SINGLE PHASE RECLOSING	ms	
63.3	CORONA EXTINCTION VOLTAGE	kV	
64	TOTAL CREEPEAGE DISTANCE		
64.1	TO GROUND	mm	
64.2	BETWEEN TERMINALS	mm	
65	SF6 CIRCUIT BREAKERS		
65.1	QUANTITY OF SF6 PER POLE AT RATED PRESSURE	cu.m	
65.2	GUARANTEED MAXIMUM LEAKAGE RATE PER YEAR	kg/ sq.cm	
65.3	RATED PRESSURE OF SF6 IN OPERATING CHAMBER	kg/ sq.cm	
65.4	LIMITS OF PRESSURE AT WHICH BREAKER OPERATES CORRECTLY	kg/ sq.cm	
65.5	MINIMUM TIME DIFFERENCE BETWEEN EACH MAKE/ BREAK OPERATION	ms	
66	IMPACT LOADING OF FOUNDATION DESIGN		
67	SEISMIC LEVEL FOR WHICH BREAKER IS DESIGNED	g	
68	MIN. SAFETY CLEARANCE FROM EARTHED OBJECTS		
69	NOISE LEVEL IN BASE OF BREAKER AND UPTO 50 M DISTANCE FROM BASE	dB	
70	THERMAL RATING OF AUXILIARY DC CONTACTS		
71	BREAKING CAPACITY OF AUXILIARY CONTACTS		
72	Pre-insertion resistor requirement		
72.1	Rating	Ohms	
72.2	Minimum electrical pre-insertion time	ms	
72.3	Opening of PIR contacts		
72.4	PIR contacts shall open immediately after closing of main circuits or		
72.5	Alteast 5 ms prior to opening of main contacts at rated air/ gas pressure where PIR contacts remain close		
73.0	Confirm whether in line with specifications	Yes/ No	

CURRENT TRANSFORMERS

SL.NO	DETAILS	UNIT	
1.0	Name of Manufacturer and country		
2	Designation		
3	Type/Application		
4	Quantity		
5.0	Applicable standards		
6	Nominal system voltage and frequency	kV, Hz	
7	Highest system voltage	kV	
8.0	Rated lightning impulse withstand voltage	kVp	
9.0	Rated switching impulse withstand voltage	kVp	
10.0	Rated one minute power frequency withstand voltage of		
10.1	Primary	kVrms	
10.2	Secondary	kVrms	
11	System neutral earthing		
12	Number of cores		
13	Whether it is possible to adjust tap setting of any core independent of other cores ?	Yes/No	
14	Rated short time withstand current and time	kA/sec	
15	Dynamic rating	kA	
16	Rated extended primary current	%	
17	Temperature rise of windings at rated current and burden over design ambient temperature	°C	
18	Class of insulation of windings		
19	Creepage distance of support insulator	mm/kV	
20	Total weight	kg	
21	Total height	mm	
22	CT details such ratio/class, etc. as per SLD	Yes/No	
23	No. of cores & core details	-	
24	Type test certificate enclosed	Yes/No	
25	Technical/Description manual enclosed with Bid	Yes/No	
26	Cantilever strength	kg	
27	Type of CT (Live or dead tank)		

28	Rated continuous current	Amps	
29	No. of primary winding		
30	Output burden (for all cores)		
31	Knee point voltage at different taps (for all cores)	V	
32	Maximum exciting current at knee point voltage at different ratios (for all cores)	mA	
33	Secondary winding resistance for all ratios and cores		
34	Instrumentation security factor at different ratios for metering cores		
35	Radio Interference voltage	microV	
36	Corona excitation voltage	kVrms	
37	Partial discharge level	pC	
38	Standard to which oil confirms		
39	Overall General arrangement drawing of CT is to be enclosed	Yes	
40.0	Confirm whether in line with specifications	Yes/ No	

CAPACITOR VOLATGE TRANSFORMERS

SL. nO.	DETAILS	UNIT	
1.0	GENERAL		
1.1	Name of Manufacturer and country		
1.2	Applicable Standards		
1.3	Type		
1.4	Quantity	Nos.	
1.5	Nominal system voltage	kV	
1.6	Highest system voltage	kV	
1.7	Frequency	Hz	
1.8	System neutral earthing		
a	Type		
b	Coefficient of earthing		
1.9	Insulation withstand level		
a	1.2/50 μ Sec. Impulse withstand voltage	kV (peak)	
b	One minute power frequency withstand voltage of secondary winding	kV (rms)	
c	One minute power frequency withstand voltage of H.F. terminal	kV (rms)	
d	One minute power frequency test voltage of Capacitor	kV (rms)	
e	Switching impulse withstand voltage	kV(peak)	
1.10	Ambient Temperature	Deg. C	
1.11	Carrier frequency Coupling capacitance	pF	
1.12	HF Range	kHz	
2.0	DESIGN REQUIREMENTS		
2.1	Rated primary voltage	kV	
2.2	Rated secondary voltage	V	
a	S1		
b	S2		
c	S3		

2.3	Number of secondaries	Nos.	
2.4	Winding material		
3.0	Method of connection		
3.1	Primary winding		
3.2	Secondary winding		
a	S1		
b	S2		
c	S3		
3.3	Application		
a	S1		
b	S2		
c	S3		
3.4	Rated burden		
a	S1		
b	S2		
c	S3		
d	Total simultaneous burden (S1+S2+S3)		
e	Rated total thermal burden		
3.5	Rated power factor		
a	S1		
b	S2		
c	S3		
3.6	Accuracy class		
a	S1		
b	S2		
c	S3		
3.7	Rated capacitance		
a	of high voltage capacitor	pF	

b	of intermediate voltage capacitor	pF	
3.8	Bandwidth	kHz	
4.0	Rated voltage factor and corresponding rated time		
5.0	Class of winding insulation		
6.0	Max. wdg. temp. at 110% excitation and rated burden		
7.0	Creepage distance	mm/kV	
8.0	Secondary Cable/conduit size	sq.mm	
9.0	Earthing conductor Material		
9.1	Size	sq.mm	
10.0	Seismic coefficient		
11.0	Radio interference voltage (for VT's rated at 220 kV and above)	μv	
12.0	Corona Extinction voltage	kV (rms)	
13.0	Cantilever strength of assembled CVT at terminal point		
14.0	TESTS		
14.1	Whether similar equipment is Type tested as per IEC186 and in successful operation for at least 2 years	Yes/No	
14.2	Type test certificate enclosed	Yes/No	
15.0	Technical/Description manual enclosed with Bid	Yes/No	
16.0	Whether bird barrier provided	Yes/No	
17.0	Whether corona ring provided	Yes/No	
18.0	Test voltage of H.F. Terminal	kVrms	
19.0	Test voltage of capacitor	kVp	
20.0	total weight	kg	
21.0	Quantity of oil	litre	
22.0	Whether CVT's are hermetically sealed ?	Yes/No	
	If so, Furnish the arrangement of sealing.		
23.0	Overall General arrangement drawing of CVT is enclosed ?	Yes/No	
24.0	Confirm whether in line with specifications	Yes/ No	

ISOLATORS/GROUNDING SWITCHES

SL. NO.	DETAILS	UNIT	
1	MANUFACTURER'S NAME AND COUNTRY OF MANUFACTURE		
2	MANUFACTURER'S TYPE AND DESIGNATION		
3	APPLICATION		
4	QUANTITY		
	a) WITH ONE EARTH SWITCH		
	b) WITHOUT EARTH SWITCH		
	c) WITH TWO EARTH SWITCH		
5	APPLICABLE STANDARD		
6.1	TYPE & ENDURANCE CLASS OF DISCONNECTOR AND MOUNTING		
6.2	Endurance class of Earth Switch		
7	EXECUTION OF POLES (GANG OPERATED THREE PHASES/ THREE INDIVIDUAL PHASES)		
8	VOLTAGE AND FREQUENCY	kV & Hz	
9	POWER FREQUENCY WITHSTAND VOLTAGE	kV (rms)	
10	LIGHTNING IMPULSE WITHSTAND VOLTAGE	kVp	
11	SWITCHING IMPULSE WITHSTAND VOLTAGE	kVp	
12	NORMAL CURRENT	A	
13	SHORT TIME WITHSTAND CURRENT AND DURATION	kA & sec.	
14	PEAK WITHSTAND CURRENT	kAp	
15	SHORT CIRCUIT MAKING CURRENT OF EARTHING SWITCH	kA	
16.1	BREAKING CAPACITY OF LINE CHARGING CURRENT	A/pf	
16.2	BREAKING CAPACITY OF MAGNETISING CURRENT	A	
17	OPERATING MECHANISM		
17.1	OPERATING DEVICE		
17.1.1	MAIN DISCONNECTOR		
17.1.2	EARTH SWITCH		
17.2	EMERGENCY OPERATION		
17.2.1	MAIN DISCONNECTOR		
17.2.2	EARTH SWITCH		
17.3	OPENING TIME OF ISOLATOR AND EARTH SWITCH		
17.4	CLOSING TIME OF ISOLATOR AND EARTH SWITCH		
18	MAXIMUM TEMPERATURE RISE OF CURRENT CARRYING PARTS WHEN CARRYING RATED CURRENT CONTINUOUSLY OVER AMBIENT TEMPERATURE	°C	

19.1	DIELECTRIC WITHSTAND CAPACITY OF COMPLETELY ASSEMBLED ISOLATOR/ EARTH SWITCH		
20	CONTACTS AND MATERIAL OF CURRENT CARRYING PARTS		
	a) TYPE OF MAIN AND ARCING CONTACTS		
	b) MATERIAL OF CONTACTS		
	i) MAIN		
	ii) ARCING		
	c) WHETHER CONTACTS ARE SILVER COATED	Yes/No	
	d) MATERIAL USED FOR CURRENT CARRYING PARTS		
21	<u>CLEARANCE</u>		
	a) BETWEEN POLES	mm	
	b) BETWEEN LIVE PARTS AND EARTH (MINIMUM)	mm	
	c) BETWEEN LIVE PARTS WHEN THE SWITCH IS OPEN		
	i) ON THE SAME POLE	mm	
	ii) BETWEEN ADJACENT POLES	mm	
22	TORQUE REQUIRED TO OPERATE THE GANG OPERATED DISCONNECTOR	Nm	
23	<u>INSULATOR DATA</u> (FOR COMPLETE STACK)		
24	a) MANUFACTURER'S NAME AND COUNTRY		
	b) TYPE		
	c) NUMBER OF UNITS		
	d) HEIGHT OF THE STACK	mm	
	e) BOLT CIRCLE DIAMETER	mm	
	f) TORSIONAL STRENGTH	Nm	
	g) CANTILEVER STRENGTH	kG	
	h) VISUAL DISCHARGE VOLTAGE	kV	
	i) DRY ARCING DISTANCE	mm	
	j) POWER FREQUENCY PUNCTURE VOLTAGE	kV	
25	<u>SWITCH DESIGN</u>		
	a) ROTATING/TILTING/LIFTING ETC.		
	b) HORIZONTAL/VERTICAL ETC.		
	c) SINGLE BREAK/DOUBLE BREAK ETC.		
26	RATED OUTPUT OF MOTOR	kw	
27	<u>TERMINAL STUD</u>		
	a) WHETHER HORIZONTAL OR VERTICAL		
	b) DIAMETER	mm	
	c) LENGTH	mm	
28	<u>CLAMPS/CONNECTORS</u>		
	a) CLAMP MATERIAL		
	b) BOLT MATERIAL		

	c) RANGE OF DIAMETER OF CONDUCTORS THAT CAN BE RECEIVED		
	d) MAXIMUM TEMPERATURE RISE WHEN CARRYING RATED CURRENT OVER SPECIFIED AMBIENT TEMPERATURE	°C	
	e) WEIGHT OF EACH TYPE OF CLAMP	kg	
	f) WHETHER HORIZONTAL/VERTICAL TAKE-OFF		
	g) FLEXIBLE/RIGID		
29	<u>SUPPORTING STRUCTURES</u>		
29.1	MATERIAL OF SUPPORTING STRUCTURES RCC/STEEL		
29.2	WHETHER CALCULATIONS FOR THE DESIGN OF SUPPORTING STRUCTURES ENCLOSED	Yes/No	
29.3	WHETHER STRUCTURAL DRAWINGS ENCLOSED	Yes/No	
30	TOTAL WEIGHT OF DISCONNECTOR (3 PHASE/1PHASE)	Kg	
31	VISUAL DISCHARGE VOLTAGE FOR COMPLETE DISCONNECTOR WITH FITTINGS (FOR 132 kV AND ABOVE)	kV	
32	RIV FOR COMPLETE DISCONNECTOR WITH FITTINGS (FOR 132 kV AND ABOVE)	µV	
33	WHETHER GENERAL ARRANGEMENT DRAWING ENCLOSED	Yes/No	
34	WHETHER ALL TYPE TEST REPORTS ARE ENCLOSED	Yes/No	
35	WHETHER DEVIATIONS IN DATA SHEET 'A' ARE FURNISHED	Yes/No	
36	CORONA EXTINCTION VOLTAGE	kV (rms)	
37	NO. OF NO & NC AUX. CONTACTS FOR PURCHASER'S USE		
	a) MAIN SWITCH	Nos.	
	b) EARTH SWITCH	Nos.	
38	POLE DISCREPANCY CIRCUIT REQUIRED	Yes/No	
39	PURCHASER'S EARTHING CONDUCTOR (MATERIAL & SIZE)	mm x mm	
40	AUXILIARY SUPPLY		
	FOR MOTOR		
	FOR CONTROL		
41	INTERLOCKS WITH CIRCUIT BREAKER (ELECTRICAL/MECHANICAL)		
42	NO. OF POLES		
43	RATED MECHANICAL TERMINAL LOAD		
44	THERMAL RATING OF AUXILIARY DC CONTACTS		
45	BREAKING CAPACITY OF AUXILIARY CONTACTS		
46.0	Confirm whether in line with specifications	Yes/ No	

SURGE ARRESTERS

SL. NO.	DETAILS	UNIT	
1	General		
1.1	Manufacturer's Name and Country of Manufacture		
1.2	Manufacturer's type and Designation		
1.3	Application	Indoor/ Outdoor	
1.4	Quantity	Nos.	
1.5	type of Arrester,		
	Gapless Metal Oxide	Yes / No	
1.6	System Voltage		
	– Nominal	kV	
	– Highest	kV	
1.7	type of System Neutral Earthing		
1.8	Short Circuit Current at Arrester Location	kA	
1.9	Maximum Duration of Earth Fault	Sec.	
1.10	Impulse Withstand Voltage Value of Equipment to be Protected		
	A) High current short duration	kV (peak)	
	B) Low current long duration	kV (peak)	
1.11	Rated Frequency	Hz	
1.12	Coefficient of Earthing		
1.13	Temperature Limits		
1.14	Seismic Requirements		
1.15	Wind Velocity		
1.16	Variation In Frequency		
1.17	Altitude	Meters	
	Is Altitude Correction Factor Applicable	Yes / No	
1.18	Applicable standards		
2	Rated Values		
2.1	Rated Arrester Voltage	kV	
	Continuous Operating Voltage	kV	
2.2	Nominal Discharge Current	kA	
2.3	Maximum Residual Voltage for,		
	Lightning Current Impulse at Nominal Discharge Current	kV (peak)	
	Switching Current Impulse	kV (peak)	
2.4	Minimum Residual Voltage at Nominal Discharge Current	kV (peak)	
	Switching Current Impulse	kV (peak)	
2.5	Pressure Relief Class		
	(Short Circuit Capability)		
2.6	Long Duration Discharge Class		

	(Applicable Only for Heavy Duty Arrestors of 10kA or Above)		
2.7	Reference Current	mA	
2.8	Reference Voltage	kV	
3	Arrester Housing		
3.1	Material of Housing		
3.2	Nominal Creepage Distance	mm	
3.3	Total Creepage Distance of whole arrester housing	mm	
3.4	Suitability for Live Washing	Yes/No	
3.5	Level of Pollution		
3.6	Energy Discharge Capacity	kJ/kV	
3.7	Maximum Residual Voltage at		
	A) 5kA Nominal Discharge Current	kV (peak)	
	A) 10kA Nominal Discharge Current	kV (peak)	
	B) 20kA Nominal Discharge Current	kV (peak)	
	C) Steep fronted wave residual voltage at 10 kA	kV (peak)	
	D) Steep fronted wave residual voltage at 1 kA	kV (peak)	
	E) V-I Curve attached	Yes / No	
3.7	Maximum Value of Temporary Over-Voltages and Their Durations	kV (peak), Sec.	
3.8	Range of Milli ammeter Provided for Leakage Current Measurement	mA	
3.9	Recommended Clearances		
	A) Phase to Phase	mm	
	B) Phase to Earth	mm	
3.10	Maximum Permissible Lengths of Lead between Arrester, Discharge Counter and Earth	mtr.	
3.11	Size of The Above Lead	Sq.mm	
3.12	Rated Voltage of Insulation of Lead	kV	
3.13	total Height of the Arrester	mm	
3.14	total Weight of the Arrester	Kg	
3.15	Minimum prospective symmetrical fault current		
3.16	Partial discharge at 1.05 continuous operating voltage	pC	
3.17	ZnO block details		
	Confirm whether equipment type tested with offered type of ZnO block	Yes / No	
4	Additional Requirements		
4.1	Cantilever Strength	Kg	
4.2	Maximum Radio Interference Voltage (for 132 kV and Above)	μV	
4.3	type of Mounting		
4.4	Whether Insulating Base Required	Yes/No	
4.5	Accessories Required		
	A) Discharge Counter	Yes/No	

	B) Grading Ring	Yes/No	
	C) Clamps and Connectors	Yes/No	
	D) Leakage Current Meter	Yes/No	
	E) Earth Lead Disconnecter	Yes/No	
	F) Complete Set of Gaskets	Yes/No	
	G) Insulating Base	Yes/No	
	H) Insulated Connecting Lead between Arrester and Discharge Counter	Yes/No	
4.6	Purchaser's Conductor Sizes		
	A) Line Side	mm	
	B) Earth Side	mm	
4.7	Visual Discharge Voltage	kV	
4.8	Pressure Relief Valve	YES/NO	
4.9	Whether Drawings/Data As Specified Enclosed	Yes/No	
	Whether Power Frequency Voltage Vs Time Characteristics Enclosed	Yes/No	
5	Tests		
5.1	List of Tests to be Carried Out		
	A) type Tests		
	B) Acceptance Tests		
5.2	No of Units to be Subjected to Acceptance Tests		
6	Overall General Arrangement drawing of Surge Arrester is to be enclosed		
7.0	Confirm whether in line with specifications	Yes/ No	

LT TRANSFORMER

SL. No.	Description	Unit	
1	GENERAL		
1.1	Manufacturer's Name		
1.2	Application/Designation		
1.3	Quantity required		
1.4	Installation (Indoor/Outdoor)		
1.5	Applicable Standards		
1.6	Degree of protection as per IS:13947		
2	RATINGS		
2.1	Rating		

2.2	Number of phases & Frequency		
2.3	Type of cooling		
2.4	No load voltage HV	V	
	LV	V	
2.5	Vector Group		
2.6	Percentage Impedance	%	
2.7	Exact Turns Ratio		
3	SYSTEM VOLTAGE		
3.1	Nominal system voltage HV	V	
	LV	V	
3.2	Highest system voltage HV	V	
	LV	V	
4	NEUTRAL EARTHING		
4.1	System Neutral		
4.2	Transformer Neutral		
5	INSULATION WITHSTAND		
5.1	Impulse (1.2/50 microsec/wave)	kV	
5.2	Power Frequency HV	kV	
	(Dry & Wet) LV	kV	
6	TEMPERATURE RISE		
6.1	Reference Ambient	°C	
6.2	Oil by thermometer	°C	
6.3	Winding by resistance	°C	
7	TAP CHANGING GEAR		
7.1	Taps (on load) required		
7.2	Tappings on windings		
7.3	Total tapping range		
7.4	Steps		
7.5	Load loss at rated current at 75°C winding temperature (guaranteed, subject to + tolerance as per applicable standard)	KW	
7.6	No-load losses (core loss and dielectric loss) at 100% rated voltage and frequency, subject to + tolerance as per applicable standard	KW	
7.7	Magnetisation current at rated voltage and frequency in percent of full load current	%	
7.8	Weight		
a)	Windings	Kg	
b)	Core	Kg	
c)	Oil	Kg	
d)	Tank, coolers & fittings	Kg	
e)	Total	Kg	
7.9	Efficiency at 75°C Full Load, U.P.F.	%	

7.10	Maximum Flux Density		
a)	At rated voltage	Wb/m ²	
b)	At 110% of rated voltage	Wb/m ²	
8	Positive sequence Impedance at 75° C with 100% rating at		
a)	Principal Tap		
b)	Maximum Tap		
c)	Minimum Tap		
9	Withstand time for three phase short circuit at terminals	Sec	
10	BUSHINGS		
10.1	Voltage class		
	a) HV line end		
	b) LV line end		
	c) HV neutral		
	d) LV neutral		
10.2	Impulse(1.2/50 m sec. Wave withstand)		
	a) HV line end		
10.3	Power frequency withstand		
	a) HV line end		
	b) LV line end		
	c) HV neutral		
	d) LV neutral		
10.4	Minimum clearance in air (in mm)		
	a) HV phase to phase		
	b) LV phase to phase		
	c) HV phase to earth		
	d) LV phase to earth		
10.5	Minimum creepage distance (in mm)		
	a) HV line end		
	b) LV line end		
	c) HV neutral		
	d) LV neutral		
10.6	CT. details		
11	TERMINAL CONNECTIONS		
11.1	HV line end bushing/cable box/cable box with disconnecting chamber		
11.2	LV line end bushing/cable box/cable box with disconnecting chamber		
11.3	HV neutral bushing/cable box/cable box with disconnecting chamber		

11.4	LV neutral bushing/cable box/cable box with disconnecting chamber		
11.5	Bushing Terminals		
	a) Required		
	b) Size of take off conductor		
11.6	Cable Box, Lugs and Glands		
	a) Required		
	b) Cable details		
12	EARTHING TERMINAL		
12.1	Material of Conductor		
12.2	Size of conductor		
13	MISCELLANEOUS		
13.1	Wheels		
	a) Plain/Flanged		
	b) Unidirectional/Bidirectional		
13.2	Vacuum withstand capability		
	Main tank with bushing radiators, fittings & accessories		
14	OPTIONAL FITTINGS REQUIRED		
14.1	Dial type thermometer with two contacts for oil temp. as per clause 7.1 of Section-D	Yes/No	
14.2	Magnetic oil level gauge with low oil level alarm contact as per clause 7.2 of Section D	Yes/No	
14.3	Gas and oil actuated (i.e.BUCHHOLZ) relay	Yes/No	
14.4	Gas sampling device as per clause 7.4 of section-D	Yes/No	
14.5	Winding temperature indicator as per clause 7.5 of section-D	Yes/No	
14.6	On load tap changing mechanism as per clause 7.6 of section-D	Yes/No	
14.7	Valves per clause 7.7 of section-D	Yes/No	
14.8	Four plain rollers in place of fixing channels	Yes/No	
15	EVALUATION & PENALTY		
15.1	Formula for evaluation of Bids		
15.2	Rates of penalty for exceeding the guaranteed losses		
16	ESSENTIAL SPARES		
16.1	Complete set of gaskets		
16.2	Bushing of each type		
16.3	CT of each type		
16.4	Dial type thermometer		
16.5	Oil level gauge		
16.6	Complete set of winding temperature indicating equipment		

16.7	Explosion vent diaphragms		
16.8	Silica-gel breather		
16.9	Buchholz relay or fault pressure relay		
16.10	One valve of each type		
17	Confirm whether similar equipment are type tested and are in successful operation for atleast two years	Yes/No	
18	Confirm whether similar equipment is tested for dynamic short circuit withstand capability. (furnish details)	Yes/No	
19	Drawing number of the general outline drawing enclosed with the bid, showing the transformer with all its fittings and accessories in plan, front and side elevations and other relevant details.		
20	Confirm whether in line with specifications	Yes/ No	

1.1KV POWER & CONTROL CABLES

SL. NO.	DETAILS	UNIT	
1	Name of the Manufacturer		
2	Nominal Power System Voltage		
3	Maximum System Voltage for continuous operation		
4	System Neutral Earthing		
5	Design ambient air temperature	°C	
6	FRLS PVC outer sheath required		
7	SPECIFIC REQUIREMENTS & QUANTITY		
8	CABLE CATALOGUE/GTP ENCLOSED?		
9	Applicable standards		
10	Continuous current rating		
11	short circuit capacity		
a	short circuit current		
b	Duration of short circuit		
c	conductor temp. allowed for the short circuit duty (deg.C)		
d	Formula relating short circuit current(rms) and duration (sec.)		
12	Conductor		
a	material		
b	grade		
c	normal cross-sectional area		
d	no. and diameter of wire		
13	Insulation		
a	Composition of insulation		
b	Nominal thickness of insulation	mm	

14	inner sheath		
a	material		
b	calculated diameter over the laid up cores	mm	
c	minimum thickness of sheath	mm	
15	Armour		
a	type and material of armour		
b	calculated diameter under armour	mm	
c	nominal diameter of round armour wire		
d	nominal size of wire/ strip		
e	short circuit capacity of armour alongwith formulae		
f	maximum DC resistance at 20 deg.C		
16	Outer sheath		
a	material		
b	calculated diameter under sheath		
17	Safe pulling force when pulled by puling eye on the conductor		
18	Test voltage		
a	High voltage test		
b	water immersion test voltage		
19	minimum bending radius permissible		
20	Confirm that all the cables approved by BIS or other international standard organizations and amarked as such.	Yes/No	
21	Whether the cables are type tested as per IS/ International Standard.	Yes/No	
22	Confirm whether in line with specifications	Yes/ No	

LT SWITCHGEAR

SL.No	Details	Unit	
1	<u>SPECIFIC PARTICULARS</u>		
1.1	Switchgear designations		
1.2	Single front or double front	SF/DF	
1.3	Applicable Standard		
1.4	Fully drawout/semi drawout/Fixed	FD/SD/F	
1.5	Total dimensions of each complete switchgear L x W x D	mm	
1.6.1	Width of each vertical section with cable alley	mm	
1.6.2	Width of cable alley only	mm	
1.7	Minimum clear space required		
	a) In front	mm	
	b) Back	mm	
1.8	Max. cubicle weight with components	kg	
1.9	Have all the feeders and components specified in enclosed Drawings and Data Sheets A - 3 been provided ?		

2	<u>GENERAL PARTICULARS</u>		
2.1	Sheet steel		
	a) Cold rolled/Hot rolled		
	b) Thickness :		
	i) Frames & load bearing members	mm	
	ii) Door	mm	
	iii) Rear cover	mm	
	iv) Side and top covers	mm	
	v) Panel partitions	mm	
2.2	Degree of protections provided by the enclosure (As per IS : 13947)		
2.3	Earth busbar size	Sq.mm	
2.4	<u>BUSBAR</u>		
	a) Material of busbars		
	b) Section	Sq.mm	
	c) Continuous current rating at Ambient temperature	A, °C	
	d) Whether busbars have been insulated	Y/N	
	e) Type of insulation		
	f) Temperature rise over the reference ambient when carrying rated current	°C	
	g) Material of busbar supports		
	h) Clearance in air :		
	i) Between phases	mm	
	ii) Between phases earth	mm	
	i) Short time rating (One Sec.)	kA	
	j) Momentary rating (peak)	kA	
	k) Degree of protections		
3	<u>CIRCUIT BREAKERS</u>		
3.1	Maker's name		
3.2	Circuit breakers type (air break and or MCCB)		
3.3	Rated voltage	V	
3.4	Rated operating duty		
3.5	Rated current	A	
3.6	Derating factor for operation under site conditions		
3.7	Rated symmetrical breaking current at rated voltage. (Indicate power factor)	kA	
3.8	Rated peak making current	kA	
3.9	Rated short time withstand rating (for 1 sec.) (For MCCB, BIDDER to indicate the time)		
3.10	Operating mechanism type		
3.11	Limits of voltage for satisfactory operation of the following devices as a % of normal voltage		
	i) Operating mechanism	%	

	ii) Closing at normal voltage	%	
	iv) Trip coil	%	
3.12	Power required for closing at normal voltage	W	
3.13.	Power required for tripping at normal voltage	W	
3.14	Spring charging motor details :		
	i) Rating	kW	
	ii) Rated voltage	V, AC/DC	
	iii) Spring charging	Sec.	
3.15	Overload release provided	YES/NO	
3.16	Short circuit release settings and time delay features	YES/NO	
3.17	Undervoltage release setting	YES/NO	
3.18	Key interlocking required	YES/NO	
3.19	Have electrical and mechanical anti-pumping features been provided	YES/NO	
	Shunt Trip required	YES/NO	
3.20	Have type test certificates been enclosed ?	YES/NO	
3.21	Minimum no. of auxiliary contacts for ACBs for Purchaser's use on fixed portion of the cubicle		
	Emergency Manual Operation required in addition to electrical operating devices:		
	i) For spring charging & Closing	YES/NO	
	ii) For Tripping	YES/NO	
3.22	Degree of protections		
4	<u>MCCBS</u>		
4.1	Moulded case circuit breakers to be provided		
	A) for motor control circuits	YES/NO	
	B) for other circuits	YES/NO	
4.2	Voltage, frequency & no. Of phases		
4.3	Rated operating duty		
4.4	Rated breaking capacity (at 415v 0.25 p.f.)	kA	
4.5	Rated making current	kA	
4.6	Rated current at site reference ambient temperature		
4.7	ON/OFF operation :		
	Manual	YES/NO	
	Remote power operated	YES/NO	
4.8	Releases required :		
	Overload inverse time	YES/NO	
	Under voltage	YES/NO	
4.9	Minimum no. of auxiliary contacts for Purchaser's use on fixed portion of the cubicle		
5	<u>AIR BREAK SWITCHES</u>		
5.1	Make		

5.2	Type		
5.3	Rated Voltage	V	
5.4	Maximum prospective fault current withstand of composite unit of switch and fuse	kA (peak)	
6	<u>FUSES</u>		
6.1	Make		
6.2	Type		
6.3	Rated voltage	V	
6.4	Rated current for individual circuits to be provided as per requirements of protection coordination	YES/NO	
7	<u>CONTACTORS</u>		
7.1	Make		
7.2	Rated duty		
7.3	Rated Utilisation Category		
7.4	Rated (thermal) current provided as per specification	YES/NO	
7.5	Rated voltage of auxiliary contacts	V	
7.6	Rated voltage of coil	V	
7.7	Rated breaking capacity	Factor of rated current	
7.8	Rated making capacity	Factor of rated current	
7.9	No of auxiliary contacts :		
	I) Normally open		
	ii) Normally closed		
8	<u>SINGLE PHASING PREVENTERS</u>		
8.1	Is it in built-in bimetal thermal overload relay	YES/NO	
9	<u>CURRENT TRANSFORMERS</u>		
9.1	Make		
9.2	All other parameters of CT as per enclosed SLD/list and Section-D	YES/NO	
9.3	Accuracy class		
10	<u>VOLTAGE TRANSFORMERS</u>		
10.1	Make		
10.2	Ratio	V/V	
10.3	Output per phase	VA	
10.4	Accuracy class		
10.5	Over voltage factor		
10.6	Class of insulation		
11	<u>CONTROL TRANSFORMERS</u>		
11.1	Make		

11.2	Ratio		
11.3	Class of insulation		
11.4	Rated output	VA	
12	<u>INSTANTANEOUS OVER CURRENT RELAY</u>		
12.1	Application (phase fault or earth fault)		
12.2	Make		
12.3	Type		
12.4	Setting range		
13	<u>INVERSE TIME AND THERMAL OVER CURRENT RELAY</u>		
13.1	Application		
13.2	Make		
13.3	Type		
13.4	Current setting range		
13.5	Time setting range at 10 times the current setting	Sec.	
14	<u>UNDERVOLTAGE RELAY</u>		
14.1	Make		
14.2	Type		
14.3	Voltage rating	V	
14.4	Setting range	V	
15	<u>AUXILIARY RELAYS AND TIMERS</u>		
15.1	Make		
15.2	Type		
15.3	Coil voltage	V	
16	<u>CONTROL/SELECTOR SWITCH</u>		
16.1	Make		
16.2	Type designation		
17	<u>VOLTMETER</u>		
17.1	Make		
17.2	Type		
17.3	Accuracy class		
18	<u>AMMETER</u>		
18.1	Make		
18.2	Type		
18.3	Accuracy class		
19	<u>WATTMETER</u>		
19.1	Make		

19.2	Type		
19.3	Accuracy class		
20	<u>INDICATING LAMPS</u>		
20.1	Make		
20.2	Type		
20.3	Voltage	V	
20.4	Wattage of lamp	W	
21	<u>PUSH BUTTONS</u>		
21.1	Make		
21.2	No of contacts:		
	i) Normally open		
	ii) Normally closed		
21.3	Contact rating	A	
22	<u>SPACE HEATER</u>		
22.1	Make		
22.2	Rated voltage	V	
22.3	Heater output for each vertical panel	W	
22.4	Thermostat at setting °C		
23	<u>WIRING AND TERMINAL BLOCKS</u>		
23.1	Voltage grade	kV	
23.2	Insulation		
23.3	Minimum size of conductor for :		
	i) Power wiring	Sq.mm	
	ii) Control wiring	Sq.mm	
23.4	Type of terminal blocks :		
	i) For withdrawable Type		
	ii) For Fixed type		
23.5	Minimum current rating of terminal blocks	A	
23.6	Whether terminals for CT's have been provided with short circuiting facilities	YES/NO	
24	<u>PUSH BUTTON STATION</u>		
24.1	Metal Enclosure :		
	i) Die-cast aluminium/sheet metal of 2mm thickness		
	ii) Degree of protection		
24.2	Gland plate and cable glands provided	YES/NO	
24.3	Facility for fixing on wall/structure provided	YES/NO	
24.4	No. of Contacts :		
	i) Normally open		
	ii) Normally closed		
24.5	Contact rating :		
	i) At 240 V AC	A	

	ii) At 220 V DC	A	
24.6	Terminal blocks with identification nos. provided for external connections.	YES/NO	
25	Confirm whether Manufacturer's have supplied 50 Nos drawout Air circuit breaker Panels out of which 5 Nos. are with CT and relaying scheme	YES/NO	
26	Confirm whether Manufacturer's have supplied 50 Nos. MCC panels similar to the offered panels	YES/NO	
27	Confirm whether 100 nos.(at least) circuit breakers of the make and type being offered are already been operating satisfactorily	YES/NO	
28	Manufacturer's name and address		
29	Confirm whether equipment offered are from manufacturer and they are type tested as per IS/ International standard and are in successful operation for two years	YES/NO	
30	Confirm whether in line with specifications	Yes/ No	

LIGHTING SYSTEM

SL. NO.	DETAILS	UNIT	
1.0	Lighting Fixtures & Accessories		
1.1	Manufacturer's Name and address		
	a) Fixtures		
	b) Accessories		
1.2	Applicable Standards for		
	a) Fixtures		
	b) Accessories		
2.0	Conduits & Accessories (For each type & size)		
2.1	Manufacturer's name and address		
2.2	Applicable standard		
3.0	Junction Boxes (For each type & size)		
3.1	Manufacturer's name and address		
3.2	Degree of protection for enclosure		
4.0	Lighting Panels (For each type & size)		
4.1	Manufacturer's name and address		
4.2	Degree of Protection		
5.0	Lighting Transformer		
5.1	Manufacturer's name and address		
5.2	Rating (KVA)		
5.3	Standards Applicable		
5.4	Degree of protection for enclosure		
6.0	Lighting poles		

6.1	Manufacturer's name and address		
6.2	Dimensions		
7.0	Lighting Wires		
7.1	Manufacturer's name and address		
7.2	Voltage grade	V	
7.3	Cross section of conductor		
8.0	Confirm whether in line with specifications	Yes/ No	

BATTERY & BATTERY CHARGER

A.BATTERY CHARGER

SL. NO.	DETAILS	UNIT	
1.0	<u>Manufacturer's Name</u>		
2.0	<u>Type</u>		
3	Ratings	A	
3.1	Supply voltage	V	
3.2	Phase	ph	
3.3	Hz	Hz	
3.4	(a) Variation in supply Voltage	%	
3.5	(b) Variation in supply frequency	%	
3.6	Short Circuit level	kA	
3.7	Type of earthing		
3.8	Output voltage		
	a) Nominal	V DC	
	b) Setting range	V DC	
3.9	Rated output	kW	
4	<u>GENERAL</u>		
4.1	Number required		
4.2	DC System Voltage (Nominal)	V	
4.3	DC System Earthing		
4.4	Ambient Design Temperature	°C	
5	<u>DC BUS LOAD</u>		
5.1	Total continuous DC load	A	
5.2	Short time loads (Additional to continuous loads)		
	a) Momentary tripping/Emergency/Momentary Load Transfer/momentary closing	A	
	b) Starting / Running current of Largest connected DC Motor	A/A	

6	<u>BATTERY DETAILS</u>		
6.1	Float/Trickle charging current of battery	mA	
6.2	a) Boost Charging Current of Battery (Maximum)	A	
	b) Boost Charging Voltage of Battery (Maximum)	V	
6.4	Maximum time for Boost charging of Battery	Hr	
6.5	Battery capacity & no. of cells	AH	
6.6	Battery type (Lead acid or Ni-Cd).		
7	<u>PERFORMANCE</u>		
7.1	DC voltage setting adjustment for float charger	%	
7.2	Voltage stabilisation for constant voltage regulator.	%	
7.3	Maximum permissible variation in DC voltage (no load to full load)	%	
7.4	D.C.voltage setting adjustment for boost charging	%	
7.5	D.C. current adjustment for boost charging	%	
7.6	Current stabilisation for constant current regulator for boost charger	%	
7.7	Minimum permissible power factor at rated continuous load		
7.8	Permissible ripple content at rated continuous load	%	
7.9	Maximum permissible harmonics with or without battery	%	
8.0	<u>Type of AVR/controller</u>		
8.1	Voltage regulation with AVR, when supply voltage fluctuation is $\pm 10\%$ and frequency fluctuation is $\pm 5\%$		
8.2	Voltage regulation with manual controller	%	
8.3	Indicate the protective devices provided		
9	Type of voltage/current control and adjustment provided for boost charger		
10	Guaranteed efficiency		
10.1	At 50% load		
10.2	At rated load		
11	Power factor		
11.1	At 50% load		
11.2	At rated load		
12	<u>Maximum permissible temperature rise over ambient</u>		
12.1	Rectifier transformer	$^{\circ}\text{C}$	
12.2	Rectifier cells	$^{\circ}\text{C}$	
12.3	Smoothing reactor	$^{\circ}\text{C}$	
13	Class of insulation		

13.1	Rectifier transformer		
13.2	Smoothing reactor		
14	Type of rectifier cell		
15	Method of cooling		
15.1	Rectifier cells		
15.2	Transformer		
16	Whether rectifier and transformer are mounted in the same cubicle or in different cubicles	YES/NO	
17	Ripple content at rated load		
17.1	With battery		
17.2	Without battery		
18	<u>Rectifier and Blocking Diodes</u>		
18.1	Make and Type		
18.2	RMS current rating		
18.3	Peak inverse voltage continuous		
19	<u>Silicon controlled Rectifiers (SCR)</u>		
19.1	Make and Type		
19.2	RMS current rating		
19.3	Peak inverse voltage continuous		
20	Fault indicating lamps and necessary circuit provided as required	YES/NO	
21	Potential free contacts for each fault provided		
22	Overall dimensions of charger (L x W x H)		
23	Degree of Protection		
24	Weight		
25	Cable entry		
26	Cable Sizes		
26.1	Battery sq.mm		
26.2	DC output sq.mm		
26.2	AC input sq.mm		
27	Overall efficiency of charger		
28	Standard reference drawings enclosed		
	TCE.M2-EL-CW-S-2631 R0		
29	List of spares / accessories enclosed		
30	Confirm whether Manufacturer's have manufactured, tested, supplied, installed and commissioned battery Chargers to 10 Kw capacity similar to the offered battery Chargers	YES	
31	Confirm whether battery chargers are type tested as per specification	YES	
32	Confirm whether in line with specifications	Yes/ No	

B. BATTERY

Sl. No.	Description	Unit	
1	Application		
1	Manufacturer's name/Model Number		
2	Standards to which battery is manufactured		
3	Rated capacity		
3.2	Capacity at minimum ambient temperature and the formulae used for calculations		
3.3			
b)	Capacity at 27°C at different end cell voltages (Enclose capacity rating factor curves)		
3.3.1	15 minutes	Ah / V	
3.3.2	30 minutes	Ah / V	
3.3.3	45 minutes	Ah / V	
3.3.4	1 hour	Ah / V	
3.3.5	2 hour	Ah / V	
3.3.6	3 hour	Ah / V	
3.3.7	4 hour	Ah / V	
3.3.8	4 hour	Ah / V	
3.3.9	4 hour	Ah / V	
2	Number of battery banks required		
3	Number of cells in each bank in series (approximate)		
4	Ambient conditions Min. temp.		
	Max. temp.		
	Avg. temp.		
	RATING		
6	DC System Voltage Normal :		
7	Ampere Hour Capacity of Battery at 27°C. 10 hour rate to give final cell voltage of 1.85 Volts/cell & type		
8	(Continuous + Momentary tripping+Emergency) Load for 1 min. 'L1'	A	
	(Continuous + Emergency) Load for 179 min. 'L2'	A	
	(Continuous Load for 360 min. 'L3'	A	
9	Minimum ambient temperature for which load cycle is applicable		

10	Tentative size of cables to connect battery to external circuit		
11	Available area in battery room L x B		
12	Layout drg. No. (if any)		
13	Mounting arrangement		
14	High discharge test required	Yes/ No if yes,	
		Amps	
		Time End Cell Voltage	
15	Charging method proposed		
16	Tapped Cell arrangement for float cum boost charging arrangement.		
17	Maximum Momentary current 1 minute and voltage at the end of the duty	Amps	
18	Expected life of battery	Years	
19	Recommended charging rate		
19.1	Float charging voltage / current	V / A	
19.2	Trickle charging voltage / current	V / A	
19.3	Normal Boost charging voltage / current and duration (from fully discharged to fully charged state)	V / A	
19.4	Rapid Boost charging voltage / current (in 8 hours duration)	V / A	
19.5	Equalising charge		
	(a)Voltage / current	V/A	
	(b)Duration	Hrs	
	(c)Interval between successive equalising charges and criteria to initiate the same	days	
20	Expected fault level at bus due to battery	kA	
20.1	Internal resistance of each battery cell (fully charged)	Milli Ohms	
20.2	Total Resistance of battery including resistance of inter-cell / inter row connectors	Ohms	
20.3	Ah efficiency at rated load	%	
20.4	Watt hour efficiency	%	
20.5	Type of positive plate		
20.6	No. of positive plates / cell		

20.7	No. of cells per battery, with recommended float voltage		
20.8	Inter – cell / Inter – row connectors		
	(a)Type (lead, lead coated copper or lead coated aluminium)		
	(b)Thickness of lead coating (shall be not less than 0.025 mm as measured in accordance with IS : 6848).		
	(c)Suitable terminal provided for tapped cell cable connection.		
20.9	Whether acid level indicators, included (applicable for opaque containers)		
20.1	Type of containers		
20.11	Type of cell		
20.12	Overall dimensions		
20.13	Each cell LxWxH		
21	Whether battery room size adequate (enclose dimensioned drawing indicating battery layout)		
22	Weight of each cell		
22.1	With electrolyte	kg	
22.2	Without electrolyte	kg	
23	Are the vent plugs explosion proof	Yes / No	
24	Ventilation requirements No. of air changes required	Changes/ Hr	
25	Whether copy of the Type test reports (for a similar type & rating battery) enclosed. (clause 9.2 of write-up)		
26	List of spares / accessories enclosed (Ref. CL. 4 and CL. 10 of write-up)	Yes / No	
27	List of deviation enclosed	Yes / No	
28	Confirm whether Manufacturers have manufactured, tested, supplied, installed and commissioned batteries of 220V, 600AH capacity similar to the offered batteries and are in operation for at least 2(Two) years	Yes	
29	Confirm whether in line with specifications	Yes/ No	

INSULATOR, HARDWARE AND ASSESORIES

A. INSULATOR

SL. NO.	DETAILS	UNIT	
1.0	Name of Manufacturer and country		
2.0	Applicable standards		
3.0	General		
3.1	Highest System Voltage	kVrms	
3.2	System of Neutral Earthing		
3.3	Classification		
3.4	Insulation Levels (for use of effectively/non effectively earth system as applicable)		
3.4.1	One minute power frequency (Dry/Wet)	kVrms	
3.4.2	Lightning Impulse voltage withstand Dry	kVpeak	
3.4.3	Switching surge withstand voltage (wet)	kVpeak	
3.4.4	Creepage distance (Total)	mm	
3.4.5	Max radio interference withstand voltage at 305kV for 400kV system	Micro V	
3.4.6	Corona extinction voltage	kVrms	
4.0	Indoor Post Insulator		
4.1	post insulator designation		
4.2	Mechanical characteristic	kV	
4.2.1	Strength class		
4.2.2	Strength	N	
4.3	Dimension	kV	
4.3.1	Overall Height	kV	
4.3.2	Maximum diameter of insulating part		
4.3.3	Maximum diameter of top metal fitting with tapped centre hole	mm	
4.3.4	d) Maximum diameter of bottom metal fitting with tapped centre hole	mm	
	(Furnished details of auxiliary holes where specifically required)		
5.0	Outdoor Cylindrical Post Insulators		
5.1	Post insulator Designation		
5.2	Number of Units per String	no.	
6.0	Mechanical Characteristics		
6.1	Strength class		
6.2	Minimum Falling Load		
6.3	Bending	N	
6.4	Torsion	Nm	

6.5	Tension	N	
6.6	Compression	N	
6.7	Dimensions	mm	
6.7.1	overall Height	mm	
6.7.2	Maximum diameter of insulating part	mm	
6.7.3	Top Metal fitting		
6.7.4	Pitch circle dia.	mm	
6.7.5	No. and dia. Of tapped holes	No.	
		mm	
6.7.6	Bottom Metal fitting		
6.7.7	Pitch circle dia.	mm	
6.7.8	No. and dia. Of tapped holes	No.	
7.0	Outdoor Pedestal Post Insulators		
7.1	Insulator Designation		
7.2	Number of Units per String	No.	
8.0	Strength class		
8.1	Post Insulator Unit		
8.1.1	Designation		
8.1.2	Impulse withstand voltage	kVpeak	
8.1.3	Power frequency withstand voltage	kVrms	
8.1.4	Creepage Distance	mm	
8.1.5	Failing Load	N	
8.1.6	Bending-upright/under hung	N	
8.1.7	Tension	N	
8.1.8	Compression	N	
8.1.9	Torsion	Nm	
8.1.10	Height	mm	
8.1.11	Insulating part diameter	mm	
8.1.12	Top metal fitting pitch circle diameter	mm	
8.1.13	Bottom metal fitting pitch circle diameter	mm	
9.0	Post insulator unit's bending strength in stacks	N	
9.1	Fixing arrangement of pedestal type outdoor post insulator		
9.2	Composition of pedestal post insulator		
10.0	Confirm whether in line with specifications	Yes/ No	

B. DISC INSULATOR

SL. NO	DETAILS	UNIT	
1.0	Name of Manufacturer and country		
2.0	Applicable standards		
3.0	Type of insulator		

4.0	No. of units per string		
5.0	<u>Size</u>		
5.1	Diameter of disc	mm	
5.2	Spacing between adjacent units	mm	
6.0	<u>Weight</u>		
6.1	Each disc	kg	
6.2	Complete string	kg	
7.0	Nominal creepage distance	mm	
8.0	Whether Corona ring provided or not	Yes/ No	
9.0	Dry/ Wet Power frequency withstand voltage with corona control ring	kV	
9.1	Each disc		
9.2	Complete string		
10.0	Dry/ Wet lightning impulse withstand voltage with corona control ring		
10.1	Each disc	kVp	
10.2	Complete string		
12.0	250/2500 micro secod switching Surge withstand voltage		
12.1	Each disc	kVp	
12.2	Complete string	kVp	
13.0	Power frequency puncture withstand voltage	kV (rms)	
14.0	Electro-mechanical strength of each disc	kN	
15.0	Radio interference voltage of complete string (for 400 kV) at 320kV (rms)	microV	
16.0	Minimum Corona extinction voltage level of the complete string with Corona control ring (Dry Condition)	kV (rms)	
17.0	Drawing attached	Yes/No	
18.0	Confirm whether string type tested with offered disc insulator as per IS	Yes/ No	
19.0	Type test report attached	Yes/No	
20.0	Confirm whether in line with specifications	Yes/ No	

C CONDUCTOR

SL. NO.	DETAILS	UNIT	
1.0	Name of Manufacturer and country		
2.0	Applicable standards		
3.0	Application		

4.0	GENERAL		
4.1	Code name		
4.2	Quantity	M	
4.3	Whether atmosphere corrosive	Yes/No	
4.4	If yes, type of corrosive atmosphere :Salt laden / Ammonia etc.		
5.0	CONDUCTOR DATA		
5.1	Material and Stranding		
5.1.1	Aluminium	No.	
		mm	
5.1.2	Copper	No.	
		mm	
5.1.3	Steel	No.	
		mm	
5.3	Greasing required (Ref. Clause 5.1 of section D)	Yes/No	
6.0	SYSTEM DATA		
6.1	Voltage	kV	
6.2	No. of phases and frequency		
6.3	Sub-conductors per phase		
6.4	Ambient temperature	°C	
6.5	Continuous current per sub Conductor	A	
6.6	Short time current per sub conductor	kA, Sec	
7.0	Maker's name and country		
7.1	Aluminium rods		
7.2	Steel wire/rods		
7.3	Complete conductor		
8.0	Licence No. of using ISI certification mark, if any		
9.0	Purity of material	%	
10.0	Purity of aluminium	%	
11.0	Copper content	%	
12.0	Percentage of carbon, sulphur, phosphorous in steel wire/rod	%	
12.1	Carbon	%	
12.2	Sulphur	%	
12.3	Phosphorous	%	
12.4	Combined sulphur and phosphorous	%	
13.0	Overall diameter of conductor	mm	
14.0	Tolerance on diameter	mm	
15.0	Guaranteed ultimate breaking strength	kN	

16.0	Weight	Kg/km	
17.0	Resistance at temp 20 °C	ohms/km	
18.0	Coefficient of linear expansion	/°C	
19.0	Equivalent modulus of elasticity (average value from actual stress-strain curve)	kg/cm ²	
20.0	Galvanizing		
20.1	Minimum weight of coating	gm	
20.2	Uniformity of coating (Preece Test)		
21.0	No. of dips for duration in minutes :		
21.1	½ minute	No.	
21.2	1 minute	No.	
22.0	Maximum permissible temperature which conductor may be allowed to reach without appreciably reducing the ultimate strength of the conductor	°C	
23.0	Current rating based on specified ambient temperature and maximum temperature	A	
24.0	Standard length of conductor on one drum		
24.1	Drum	No.	
24.2	Diameter of flanges	mm	
24.3	Diameter of drum	mm	
24.4	Width of drum	mm	
24.5	Width of lagging	mm	
24.6	Thickness of lagging	mm	
24.7	Spindle hole diameter	mm	
25.0	Confirm whether type tested as per IS		
26.0	Confirm whether in line with specifications	Yes/ No	

d.EARTH WIRE

SL. NO.	DETAILS	UNIT	
1.0	Name of Manufacturer and country		
2.0	Applicable standards		
3.0	Application		
4.0	GENERAL		
4.1	Code name		
4.2	Quantity	M	

4.3	Whether atmosphere corrosive	Yes/No	
4.4	If yes, type of corrosive atmosphere :Salt laden / Ammonia etc.		
5.0	CONDUCTOR DATA		
5.1	Material and Stranding		
5.1.1	Steel	No.	
		mm	
5.2	Greasing required (Ref. Clause 5.1)	Yes/No	
6.0	SYSTEM DATA		
6.1	Ambient temperature	°C	
9.0	Purity of material	%	
10.0	Purity of Zinc	%	
12.0	Percentage of carbon, sulphur, phosphorous in steel wire/rod	%	
12.1	Carbon	%	
12.2	Sulphur	%	
12.3	Phosphorous	%	
12.4	Combined sulphur and phosphorous	%	
13.0	Overall diameter of conductor	mm	
14.0	Tolerance on diameter	mm	
15.0	Guaranteed ultimate breaking strength	kN	
16.0	Weight	Kg/km	
17.0	Resistance at temp 20 °C	ohms/km	
18.0	Coefficient of linear expansion	/°C	
19.0	Equivalent modulus of elasticity (average value from actual stress-strain curve)	kg/cm ²	
20.0	Galvanizing		
20.1	Minimum weight of coating	gm	
20.2	Uniformity of coating (Preece Test)		
21.0	No. of dips for duration in minutes :		
21.1	½ minute	No.	
21.2	1 minute	No.	

22.0	Maximum permissible temperature which conductor may be allowed to reach without appreciably reducing the ultimate strength of the conductor	°C	
23.0	Current rating based on specified ambient temperature and maximum temperature	A	
24.0	Lay length of outer steel layer	mm	
25.0	Standard length of conductor on one drum		
25.1	Drum	No.	
25.2	Diameter of flanges	mm	
25.3	Diameter of drum	mm	
25.4	Width of drum	mm	
25.5	Width of lagging	mm	
25.6	Thickness of lagging	mm	
25.7	Spindle hole diameter	mm	
26.0	Confirm whether in line with specifications	Yes/ No	

E. MARSHALLING KIOSK

- | | | |
|----|---------------------------------|---------|
| 1. | Manufacturer's Name and address | 1. |
| 2. | Thickness of sheet steel (mm) | 2. |
| 3. | Degree of protection provided | 3. |

AIR CONDITIONING SYSTEM

- | | |
|---|---------|
| 1. Name and Address of Air Conditioning system supplier | 1. |
| 2. Number of A/C system executed by the supplier and duration of successful operation as on date of bid opening . | 2. |
| 3. Window type air conditioning Unit | 3. |
| a) Make & Model | a) |

- | | | |
|----|---|----------|
| b) | Nominal Capacity (TR/Kcal/Hr.) | b) |
| c) | Nominal Air quantity (cu.m/hr -CFM) | c) |
| d) | Number of units offered | d) |
| e) | Guaranteed power consumption
for each unit | e)..... |

FIRE PROTECTION SYSTEM

- | | | |
|----|---|---------|
| 1. | Name and Address of the fire protection system
supplier | 1. |
| 2. | Number of Fire Protection System executed
by the supplier and duration of successful
operation as on date of bid opening for each
type fire protection system | 2. |
| 3. | Confirm that fire protection system supplier have
designed, erected, tested & commissioned fire
protection system of each type as in 2
) above as per the recommendations of TAC of
India or any other international reputed authority
like (FOC, London or NFPA, USA et) and are in
successful operation for at least two years. | |

CONTROL AND RELAY PANELS

- | | | |
|-------|--|------------|
| 1. | Name and address of Manufacturer of panels | 1..... |
| 2. | Manufacturer's type and designation | 2..... |
| 3. | Type of construction (Simplex/ duplex) | 3. |
| 4. | Thickness of sheet steel | 4. |
| (i) | Front | i) |
| (ii) | Back | ii) |
| (iii) | Sides | iii) |

- | | |
|--|---------|
| 5. Degree of protection | 5. |
| 6. Name of the manufacturer of relays | 6. |
| 7. DC voltage of the relays | 7. |
| 8. make and Model of static (0.2 accuracy class type) energy meters | 8. |
| 9. Confirm whether offered manufacturer of C&R panels and protective relays have tested commissioned & they are in successful operation for at least two years in 400 kV system. | 9. |

TRANSMISSION LINE PROTECTION

Numerical Distance protection Scheme -I

- | | |
|---|---------|
| 1. Name and address of Manufacturer | 1..... |
| 2. Manufacturer's type and designation | 2..... |
| 3. Switched or Non- switched type (is it with separate measurements for single/three phase faults) | 3..... |
| 4. Setting range of offset feature | 4..... |
| 5. Whether the relay is having self monitoring feature | 5..... |
| 6. Whether relay is compatible for PLCC equipment and can be used for Permissive Under reach/ over reach / Blocking scheme etc | 6..... |
| 7. Suitable for single and three phase Trip? | 7..... |
| 8. Type of shaped characteristic | 8..... |
| 9. No of tripping contacts with making capacity of 30 amp for 0.2 seconds | 9..... |
| 10 In case 16 contacts as per above clause are not available with the distance relay offered , type of tripping relay being offered | 10..... |
| 11 Maximum operating time for at 50% of the reach setting of 2 ohms and 10/20 ohms (with CVT) including all trip relays ,if any (Bidder is required to enclose isochronic | 11 |

curve with CVT on line)

- | | |
|--|---------|
| a) at SIR=4 | a)..... |
| b) at SIR=15, (3 phase faults) | b)..... |
| c) at SIR=15 (other faults) | c)..... |
| 12 IDMT earth fault relay Meeting Normal Inverse Characteristics as per IEC 60253 is being offered ass built in feature for 220 KV lines | 12..... |
| 13.If no, type of IDMT relay being offered | 13..... |
| 14.Built in features offered with the relay (YES/NO) | 14. |
| a) Disturbance recorder | a)..... |
| b) Fault locator | b)..... |
| c) Over voltage (one stage only) | c)..... |
| d) Auto reclose along with Dead line charging and check synchronisng | d)..... |

Numerical Distance protection Scheme -II

- | | |
|--|--------|
| 1.Name and address of Manufacturer | 1..... |
| 2.Manufacturer's type and designation | 2..... |
| 3. Switched or Non- switched type (is it with separate measurements for single/ three phase faults) | 3..... |
| 4. Setting range of offset feature | 4..... |
| 5. Whether the relay is having self monitoring feature | 5..... |
| 6. Whether relay is compatible for PLCC equipment and can be used for Permissive Under reach/over reach /Blocking scheme etc | 6..... |
| 7.Suitable for single and three phase Trip? | 7..... |
| 8.Type of shaped characteristic | 8..... |
| 9. No of tripping contacts with making | 9..... |

capacity of 30 amp for 0.2 seconds

- | | |
|--|---------|
| 10. In case 16 contacts as per above clause are not available with the distance relay offered , type of tripping relay being offered | 10..... |
| 11. Maximum operating time for at 50% of the reach setting of 2 ohms and 10/20 ohms (with CVT) including all trip relays ,if any (Bidder is required to enclose isochronic curve with CVT on line) | 11 |
| a) at SIR=4 | a)..... |
| b) at SIR=15, (3 phase faults) | b)..... |
| c) at SIR=15 (other faults) | c)..... |
| 12. IDMT earth fault relay Meeting Normal Inverse Characteristics as per IEC 60253 is being offered ass built in feature for 220 KV lines | 12..... |
| 13. If no, type of IDMT relay being offered | 13..... |
| 14. Built in features offered with the relay (YES/NO) | 14. |
| a) Disturbance recorder | a)..... |
| b) Fault locator | b)..... |
| c) Over voltage (one stage only) | c)..... |
| d) Auto reclose along with Dead line charging and check synchronising | d)..... |

BACKUP DIRECTIONAL OVER CURRENT

AND EARTH FAULT PROTECTION SCHEME

- | | |
|--|---------|
| 1. Name and address of Manufacturer | 1..... |
| 2. Manufacturer's type and designation | 2..... |
| 3. Three over current and one E/F elements Are whether independent or composite unit | 3. |
| 4. Type of relay (Elecromechanical/static/Numerical) | 4..... |
| 5. Directional sensitivity | 5..... |
| 6. Whether characteristic conform to IEC 255-3 | 6..... |
| 7. Over current unit setting range inverse time | 7..... |

- | | |
|--|--------|
| 8. Earth fault unit setting range inverse time | 8..... |
| 9. VT Fuse failure relay/ feature included for alarm | 9..... |

LINE OVER VOLTAGE PROTECTION RELAY

- | | |
|--|--------|
| 1. Name and address of Manufacturer | 1..... |
| 2. Manufacturer's type and designation | 2..... |
| 3. Type of relay (Elecromechanical/static/Numerical) | 3..... |
| 4. Operation indicator provided? | 4..... |
| 5. Operating time | 5..... |
| 6. Resetting time | 6..... |
| 7. Whether monitors all three phases? | 7..... |
| 8. Built in feature of Main1/Main 2 distance relay is offered . If so , which stage is offered as built in | 8..... |

DISTANCE TO FAULT LOCATOR

- | | |
|---|--------|
| 1. Name and address of Manufacturer | 1..... |
| 2. Manufacturer's type and designation | 2..... |
| 3. Built in feature of Main1/Main 2 distance relay is offered | 3..... |
| 4. Maximum registering time | 4..... |
| 5. Whether direct display unit provided? | 5..... |
| 6. Whether both phase to phase fault and phase to earth fault measuring units included? | 6..... |
| 7. Whether "On-Line" type | 7..... |
| 8. Accuracy for the typical conditions defined under technical specification | 8..... |

DISTURBANCE RECORDER

a. Acquisition unit

- | | |
|--|--------|
| 1. Name and address of Manufacturer | 1..... |
| 2. Manufacturer's type and designation | 2..... |

3.No. of analogue channels	3.....
4.No. of digital recording channels	4.....
5. Built in feature of Main1/Main 2 distance relay is offered	5.....
6.Pre-fault memory (milli seconds)	6.....
7.Post fault memory(seconds)	7.....
8.Total storage memory in seconds	8.....
9.Sampling Frequency	9.....
10.Resolution of the event channels (ms)	10.....
11.Time display present?	11.....
12.Data out put in COMTRADE is available	12.....

b.Evaluation Unit

1 Name and address of Manufacturer	1.....
2 Manufacturer's type and designation	2.....
3.No of acquisition unit that can be connected to One evaluation unit	3.....
4 Technical Parameters of evaluation unit	4
A Processor and speed	A.....
B RAM and hard disk capacity	B.....
C Additional facilities	C.....
D Details of printer	D.....
5. Details of power supply arrangement for Acquisition unit (including printer)	5.....

AUTO RECLOSE RELAY

1.Name and address of Manufacturer	1.....
2.Manufacturer's type and designation	2.....
3.Electromechanical /static/numerical	3.....
4.Auto reclose relay along with Dead line charging and check synchronisng relay	4.....

(For 132 KV lines) offered as a part of distance relay

- | | |
|--|--------|
| 5.Suitable for single and three phase? | 5..... |
| 6.Single phase dead time setting Range | 6..... |
| 7.Three phase dead time setting range | 7..... |
| 8.Reclaim time setting range | 8..... |

TRANSFORMER PROTECTION

Differential relay

- | | |
|---|--------|
| 1.Name and address of Manufacturer | 1..... |
| 2.Manufacturer's type and designation | 2..... |
| 3.Second harmonic restraint provided | 3..... |
| 4.Whether three instantaneous units provided | 4..... |
| 5.Operating Current setting range | 5..... |
| 6.Bias setting range | 6..... |
| 7.Operating time at 5X setting current | 7..... |
| 8. Resetting time | 8..... |
| 9. How ratio / phase angle corrections are being done(inter posing transformer/internal feature in the relay) | 9..... |

Restricted Earth Fault Protection

- | | |
|---------------------------------------|--------|
| 1.Name and address of Manufacturer | 1..... |
| 2.Manufacturer's type and designation | 2..... |
| 3.Operating time at 2 x setting | 3..... |

Over Fluxing relays

- | | |
|--|--------|
| 1.Name and address of Manufacturer | 1..... |
| 2.Manufacturer's type and designation | 2..... |
| 3.Whether inverse time operating characteristics | 3..... |

4. Maximum operating time	4.....
5. Accuracy of operating time	5.....
6. Resetting time	6.....

Directional O/C and E/F relays

1. Name and address of Manufacturer	1.....
2. Manufacturer's type and designation	2.....
3. Whether Characteristic will confirm to IEC255-3	3.....
4. Directional sensitivity	4.....
5. Over current unit setting range	5
a) Inverse time	a)
b) High set	b)
6. Earth fault unit setting range	6
a) Inverse time	a)
b) High set	b)

GENERAL PROTECTION /MONITORING EQUIPMENT

Trip Circuit Supervision relay

1. Name and address of Manufacturer	1.....
2. Manufacturer's type and designation	2.....
3. Whether pre-closing and post closing supervision provided?	3.....
4. Time delay	4.....

High Speed Trip Relays

1. Name and address of Manufacturer	1.....
2. Manufacturer's type and designation	2.....
3. Contact ratings	3.....
a) Make and carry continuously	a)
b) Make and carry for 0.5 sec.	b)

c) Break	c)
i). Resistive load	i)
ii) Inductive load (With L/R=40milli sec.)	ii)
4. Operating time at rated voltage (maximum)	4.....
5. Resetting time	5.....
6. Whether supervisory relays included	6.....
Local breaker back-up protection	
1. Name and address of Manufacturer	1.....
2. Manufacturer's type and designation	2.....
3. Operating time	3.....
4. Resetting time	4.....
5. Setting ranges	5
a) Current	a)
b) Time	b)
Bus bar Protection	
1. Name and address of Manufacturer	1.....
2. Manufacturer's type and designation	2.....
3. Type of relay (Electromechanical/static/Numerical)	3.....
4. Principle of operation(Biased/High impedance)	4.....
5. Operating time	5.....
6. Resetting time	6.....
7. Setting ranges	7.
(i) Current	i)
(ii) Time	ii)
8 Whether will it cause tripping for the differential current below the load current of heavily loaded feeder (Bidder shall submit application check for the same)	8.....

CONTROL PANEL EQUIPMENT

Bay Control unit

- | | |
|---|---------|
| 1.Name of Manufacturer | 1..... |
| 2.Manufacturer's type and designation | 2..... |
| 3.Type of mounting | 3..... |
| 4.Standards Applicable | 4..... |
| 5.Rated auxiliary voltage | 5..... |
| 6.No. of analog variable (specify voltage & current separately) | 6..... |
| 7.Rated Frequency | 7..... |
| 8.No. of binary inputs | 8..... |
| 9.No. of outputs | 9..... |
| 10.Language | 10..... |
| 11.Type of communication protocol supported | 11..... |
| 12.No. & Type of communication ports | 12..... |
| 13.Operating temperature range | 13..... |
| 14.System Response Time | 14..... |

Recording Meter for voltage

- | | |
|---|------------|
| 1.Name of Manufacturer | 1..... |
| 2.Manufacturer's type and designation | 2..... |
| 3.Accuracy class | 3..... |
| 4. Full span response time | 4..... |
| 5.Is it strip type recorder /digital type | 5..... |
| 6.If it is digital type | 6. |
| i) No of channels being used | i) |
| ii)Whether time tagged information is available | ii) |
| iii)Whether EMC/EMI compatibility is tested | iii) |

Recording Meter for frequency

- | | |
|--|-------------|
| 1.Name of Manufacturer | 1..... |
| 2.Manufacturer's type and designation | 2..... |
| 3.Accuracy class | 3..... |
| 4. Full span response time | 4..... |
| 5.Is it strip type recorder / digital type | 5..... |
| 6.If it is digital type | 6 |
| i) No of channels being used | (i) |
| ii) Whether time tagged information is available | (ii) |
| iii) Whether EMC/EMI compatibility is tested | (iii) |

Terminal Block

- | | |
|---|------------|
| 1.Name of Manufacturer | 1. |
| 2.Manufacturer's type and designation | 2..... |
| 3.Rated current | 3..... |
| 4.Rated voltage | 4..... |
| 5 Minimum no. of conductors of area
2.5 mm ² suitable for connection. | 5..... |
| (i) All circuits except CT.Circuits | (i) |
| (ii) C.T. Circuits | (ii) |

Control Switches

- | | |
|---|----------|
| 1.Name of Manufacturer | 1..... |
| 2.Manufacturer's type and designation | 2..... |
| 3.Number of positions provided
(Trip/Normal after trip, close, normal after close) | 3..... |
| 4.No. of contacts | 4..... |
| 5.Type of handle | 5..... |
| 6.Rating of contacts | 6. |
| a) Make and carry continuously | a) |

- | | |
|--|----------|
| b) Make and carry for 0.5 sec. | b) |
| c) Break resistive load, in Amps (d.c.) | c) |
| d) Break inductive load with $L/R=40$ m. sec in Amps. (d.c). | d) |
| 7. Life of switch in terms of million mechanical operations | 7..... |

Push Buttons

- | | |
|---------------------------------------|--------|
| 1.Name of Manufacturer | 1..... |
| 2.Manufacturer's type and designation | 2..... |
| 3.Contact ratings | 3..... |
| 4.No. of contacts | 4..... |

Annunciators

- | | |
|---|-----------|
| 1.Make | 1..... |
| 2.Type & Model No. | 2..... |
| 3.Static/ electromechanical | 3..... |
| 4.No of lamps per window | 4..... |
| 5.Lamps | 5 |
| a) Voltage | (a) |
| b) Wattage | (b) |
| 6.Minimum duration of impulse for initiating contact in millisecond | 6..... |
| 7.Type of reset self/manual | 7..... |

POWER LINE CARRIER COMMUNICATION

SL. NO.	DETAILS	UNIT	
1	COUPLING DEVICE (Phase to Phase Type)		
1.1	Name of Manufacturer and Country		
1.2	Type, Model and Catalogue Number		
1.3	Nominal primary side impedance		
1.4	Nominal secondary side impedance		
1.5	Composite loss with in pass-band		
1.6	Return loss with in pass-band		
1.7	Available Bandwidth (with 4400/6600/8800 pF CVTS)		
1.8	Nominal Peak Envelope Power (with Distortion and Inter modulation Products 80 dB down)		
1.9	Maximum number of PLC terminals that can be connected in parallel:		
a	20 W (PEP) PLC terminals		
b	40 W (PEP)PLC terminals		
c	100 W(PEP) PLC terminals		
1.10	Power Frequency Impedance between primary terminal and Earth Terminals of Coupling Device.		
1.11	No of H.F. terminals provided for carrier equipment connection		
2	HIGH FREQUENCY CABLE		
2.1	Name of Manufacturer and country		
2.2	Type, Model and Catalogue no		
2.3	Applicable standards		
2.4	Maximum attenuation per km of cable for carrier Frequency range 40 to 500 kHz		
2.5	Maximum loop resistance/ km of cable		
3	POWER LINE CARRIER TERMINAL FOR SPEECH AND DATA TRANSMISSION OR NETWORK PROTECTION		
3.1	Name of Manufacturer and country		
3.2	Type, Model and Catalogue no		
3.3	Type of Modulation		
3.4	Mode of transmission		
3.5	Carrier Frequency Range		
3.6	Nominal carrier frequency band in either direction of transmission		
3.7	Return loss within the nominal carrier frequency band		
3.8	Effectively transmitted V.F. band		
a	For speech		
b	For telephone signaling		

3.9	Return Loss within the effectively transmitted voice frequency band		
3.10	Maximum H.F Amplifier output with single /Multiple tone keying (Peak Envelope Power		
3.11	Nominal carrier frequency power (peak envelop power) at output terminals.		
4	VF TRANSMISSION TERMINAL FOR NETWORK PROTECTION SIGNALS (PROTECTION COUPLER)		
4.1	Name of Manufacturer and country		
4.2	Type, Model and catalogue number		
4.3	Whether equipment works on frequency shift principle of coded signal principle		
4.4	Whether Equipment is suitable for independently protecting two circuits		
4.5	Frequencies used in the equipment for transmission of signal for un-coded signal transmission		
a	Guard frequency		
b	Working frequency (Trip system-I)		
c	Working frequency (Trip system-II)		
d	Working frequency (Trip system (I&II)		
4.6	Criteria used for command transmission		
4.7	Transmission time corresponding to telegraph speed for transmission on PLCC channel of coded signal		
a	600 Bds		
b	400 Bds		
c	200 Bds		
4.8	Mode of transmission of guard signal		
4.9	Whether equipment is suitable for Direct circuit breaker tripping		
4.10	Whether loop test is possible		
4.11	Whether the equipment is suitable for transmitting and receiving more than two independent commands (please furnish details)		
4.12	Whether receiver design provides protection against false tripping from random noise		
5	LINE TRAPS		
5.1	Name of Manufacturer and country		
5.2	Type & Model		
5.3	System Voltage Rating		
5.4	Continuous current rating at 50°C ambient		
5.5	Continuous current rating at 65°C		
5.6	Maximum Symmetrical short circuit current rating for 1 sec. duration		
5.7	Asymmetric peak value of first half wave of rated short time current		

5.8	Rated Inductance of main coil	mH	
5.9	Blocking Range	kHz	
5.10	Minimum Guaranteed Resistive component in blocking frequency range		
5.11	Details of protection of capacitors and coils against voltage surges. Indicate type of protective device.		
5.12	Rated voltage of the arrestor (protective device)		
6	ELECTRONIC PRIVATE AUTOMATIC EXCHANGE (EPAX)		
6.1	Name of manufacturer		
6.2	Type and model		
6.3	Capacity of exchange (Subscribers & trunk lines)		
6.4	Whether compatible to both i.e PLCC & DOT lines for communication		
7	Confirm whether in line with specifications	Yes/ No	

48V BATTERY

Sr. No.	Description	Unit	
1	Application		
1	Manufacturer's name/Model Number		
2	Standards to which battery is manufactured		
3	Rated capacity		
3.2	Capacity at minimum ambient temperature and the formulae used for calculations		
3.3			
b)	Capacity at 270C at different end cell voltages (Enclose capacity rating factor curves)		
3.3.1	15 minutes	Ah / V	
3.3.2	30 minutes	Ah/ V	
3.3.3	45 minutes	Ah /V	
3.3.4	1 hour	Ah / V	
3.3.5	2 hour	Ah /V	
3.3.6	3 hour	Ah/V	
3.3.7	4 hour	Ah/V	
3.3.8	4 hour	Ah/V	
3.3.9	4 hour	Ah/V	

2	Number of battery banks required		
3	Number of cells in each bank in series (approximate)		
4	Ambient conditions Min. temp.		
	Max. temp.		
	Avg. temp.		
	RATING		
6	DC System Voltage Normal :		
7	Ampere Hour Capacity of Battery at 27°C. 10 hour rate to give final cell voltage of 1.85 Volts/cell & type		
8	Continuous load	A	
9	Minimum ambient temperature for which load cycle is applicable		
10	Tentative size of cables to connect battery to external circuit		
11	Available area in battery room L x B		
12	Layout drg. No. (if any)		
13	Mounting arrangement		
14	High discharge test required	Yes/ No if yes,	
		Amps	
	Time		
	End Cell Voltage		
15	Charging method proposed		
16	Tapped Cell arrangement for float cum boost charging arrangement.		
17	Maximum Momentary current 1 minute and voltage at the end of the duty	Amps	
18	Expected life of battery	Years	
19	Recommended charging rate		
19.1	Float charging voltage / current	V / A	
19.2	Trickle charging voltage / current	V / A	
19.3	Normal Boost charging voltage / current and duration (from fully discharged to fully charged state)	V / A	
19.4	Rapid Boost charging voltage / current (in 8 hours duration)	V / A	
19.5	Equalising charge		
	(a)Voltage / current	V/A	
	(b)Duration	Hrs	

	(c)Interval between successive equalising charges and criteria to initiate the same	days	
20	Expected fault level at bus due to battery	kA	
20.1	Internal resistance of each battery cell (fully charged)	Milli Ohms	
20.2	Total Resistance of battery including resistance of inter-cell / inter row connectors	Ohms	
20.3	Ah efficiency at rated load	%	
20.4	Watt hour efficiency	%	
20.5	Type of positive plate		
20.6	No. of positive plates / cell		
20.7	No. of cells per battery, with recommended float voltage		
20.8	Inter – cell / Inter – row connectors		
	(a)Type (lead, lead coated copper or lead coated aluminium)		
	(b)Thickness of lead coating (shall be not less than 0.025 mm as measured in accordance with IS : 6848).		
	(c)Suitable terminal provided for tapped cell cable connection.		
20.9	Whether acid level indicators, included (applicable for opaque containers)		
20.1	Type of containers		
20.11	Type of cell		
20.12	Overall dimensions		
20.13	Each cell LxWxH		
21	Whether battery room size adequate (enclose dimensioned drawing indicating battery layout)		
22	Weight of each cell		
22.1	With electrolyte	kg	
22.2	Without electrolyte	kg	
23	Are the vent plugs explosion proof	Yes / No	
24	Ventilation requirements No. of air changes required	Changes/ Hr	
25	Whether copy of the Type test reports (for a similar type & rating battery) enclosed. (clause 9.2 of write-up)		
26	List of spares / accessories enclosed (Ref. CL. 4 and CL. 10 of write-up)	Yes / No	
27	List of deviation enclosed	Yes / No	

28	Confirm whether Manufacturers have manufactured, tested, supplied, installed and commissioned batteries of 220V, 600AH capacity similar to the offered batteries and are in operation for at least 2(Two) years	Yes	
29	Confirm whether in line with specifications	Yes/ No	

DG SET

SL. NO.	DETAILS	UNIT	
1	Manufacturer'S Name and Address for		
1.1	Diesel engine along with accessories		
1.2	Alternator		
1.3	Exciter		
1.4	Battery		
1.5	Battery Charger		
1.6	D.G. set control panel (DG AMF panel)		
2	Engine		
2.1	Rating	kVA	
2.2	RPM	rpm	
2.3	No. of strokes		
2.4	Time required for starting from cold		
2.5	Type of governor		
2.5.1	At full load		
2.5.2	At 3/4 load		
2.5.3	At 1/2 load		
2.5.4	At 1/4 load		
2.6	Guranteed fuel consumption		
2.7	Lubricating oil consumption		
2.8	Mechanical efficiency	%	
2.9	Thermal efficiency	%	
2.10	Total weight	kg	
2.11	Space required including clearances		
3	Alternator		
3.1	Rated KW capacity	KW	
3.2	Rated terminal voltage	V	
3.3	Rated power factor		
3.4	Rated speed	rpm	
3.5	Rated frequency	Hz	
3.6	No. of phases		
3.7	Efficienci and power factor at		
3.7.1	110% of full load		
3.7.2	100% of full load		
3.7.3	75% of full load		
3.7.4	50% of full load		
3.7.5	25% of full load		
3.8	Permissible temperature rise		
3.8.1	Armature winding	°C	

3.8.2	Field winding	°C	
3.9	Overload capacity		
3.10	Degree of protection		
3.11	Applicable standards		
4	AMF (Auto Mains Failure) Panel		
4.1	Degree of protection		
4.2	Whether the offered DG is type tested	YES/NO	
5	Confirm whether in line with specifications	Yes/ No	