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KHOLONGCHHU HYDRO ENERGY LIMITED

A Joint Venture of Druk Green (Bhutan) & SJVN (India) Incorporated under the Companies Act of Kingdom of Bhutan, 2000

KHOLONGCHHU HYDROELECTRIC PROJECT (600 MW)

BIDDING DOCUMENT FOR

CONSTRUCTION OF BHU BUILDING & AUXILIARY WORKS AT DOKSUM/KHITSHANG, TRASHIYANGTSE

TENDER NO.: INFRA – 2022-1

TECHNICAL SPECIFICATION FOR ELECTRICAL WORK

ANNEXURE – I

A. **Design, Engineering, Manufacturing, Supply, Delivery, Erection and Commissioning of 1x500kVA, 33/0.415 kV outdoor Package Substation.**

1. **Scope Of The Works**

This covers tentative requirements for Design, engineering, manufacture, testing, supply, erection/installation, testing and commissioning of Packaged substation & all associated civil works under Power Distribution System (PDS) for BHU, New Doksum, Trashiyangtse, Bhutan. All the materials required for completion of this work is in the scope of the bidder whether specifically mentioned in the Bill of Quantities and specification or not but required to complete the work as per latest standard SQCA/IS /IEC specification.

The electrical and associated equipment shall be erected in conformity with the SQCA specifications, IS or IEC with amendments up to date for electrical works while complying in all respects with the requirements of the latest relevant rules in force at the time of execution and in conformity with the requirement of Indian Standard, codes/International codes and practices, Indian & Bhutan safety rules and all other statutory regulations of RGoB that may be relevant to erection and testing & commissioning as per requirements of IS/IEC and other details given elsewhere in the Project Documents.

The contractor shall furnish all labour, skilled and un-skilled, supervisory and administrative personnel all erection tool & tackles, testing and commissioning equipment, implements necessary for timely and effective execution of the contract. The installation work is exclusive of supply of erection material, hardware and consumable items to complete the installation under turnkey execution of the project.

Specifications for Substation Equipment

The work of substation and other connected work shall be carried out as per the IEC 61330 -General Specifications for Electrical Works (Part-IV – Substations) 1982 as amended up to date and General Specifications for Electrical Works (Part I-Internal) 1994 and General Specifications for Electrical Works (Part-II-External) 1995 as amended up to date except the following changes Reference to clause numbers of specifications is also given.

Applicable Codes and Standards

Applicable Standards:

Unless otherwise specified elsewhere in this Specification, the RMU, Switchboard (Switchgear), Instrument Transformers and other associated accessories shall conform to the latest revisions and amendments thereof of the following standards.

		IEC Standard

Switchgear		IEC62 271- 1 or equivalent
		IEC 62 271-202 or equivalent
Devices	Circuit Breakers	IEC 62 271-100 or equivalent
	Earthing switches	IEC 62 271-102 or equivalent
	Voltage detecting systems	IEC 61 243-5 or equivalent
	Switch-disconnectors	IEC 60 265-1 or equivalent
Degree of Protection	-	IEC 60 529 or equivalent
Insulation		IEC 60 071 or equivalent
Instrument Transformers	Current Transformers	IEC 60 044-1 or equivalent
	Voltage Transformers	IEC 60 044-2 or equivalent
Installation, Erection	-	IEC 61 936-1 or equivalent

1. Service Condition

- *The general operating temperature shall be from -5 °C to +40°C.*
- *Manufacturer shall declare whether the RMU is able to operate in air temperature higher than +40 °C and confirm that current de-rating is not necessary.*
- *The RMU shall be capable of being exposed to high relative humidity and ambient air/dust pollution.*

2. Packaged Substation

The complete packaged substation shall be factory assemble with separate access to transformer, HT and LT compartments. It shall be possible to install the packaged sub-station in congested areas with blocked walls on minimum two/three sides.
The substation enclosure shall be made of CRCA/GI Sheet of minimum 2.0-mm thickness. The enclosure shall be tested for internal Arc with stand capacity as per IEC-62271-202. The enclosure should not require any artificial cooling through exhaust fans etc. It should be naturally Air-cooled.
There should be proper provision of Internal Lighting of MV and LV compartments. Sufficient space should be available inside the packaged sub-station for any operating personnel to operate and work on MV and LV equipment in case of a need for performing any maintenance activity.
Safety notices and faults indicator outside the packaged substation to indicate any fault.
Packaged substation must be delivered in one single indivisible volume to avoid assembly of components at site.

3. The packaged substation will have the followings: -

H.T. Side :-

The H.T. panel shall be SF6 insulated single board comprising of incomer as SF6 insulated vacuum circuit breaker, one SF6 insulated vacuum circuit breaker for tee-off to transformer & one SF6 insulated Load Break Switch as out going to other PSS having an arrangement for incoming and outgoing connections. All live and switching parts are enclosed in 2-mm thick stainless steel tank filled with SF6 gas with suitable bar pressure for an altitude of 1500 Mtr. The RMU should be Internal Arc tested for 20 kA or higher for 1 Sec as per the IEC.

Three way 33 kV indoor non-extensible free standing with 630 Amps VCB for incomer, 250A VCB for Tee off circuit breaker and 630 A LBS for outgoing feeder enclosed in SF6 gas tank complete with all accessories as follows : -

(i) Self powered IDMT relay (50-51-50N-51N) for circuit breakers with in built Bushing/Cable Mounted protection CT's for incomer & tee off circuit breaker.
(ii) The Tee-off circuit breaker and incomer are provided with integrated earthing switches with making capacity.
(iii) Live capacitive cable indicator for ring switches
(iv) SF6 Gas pressure indicator
(v) Pad locking facility
(vi) Shunt trip coil rated for 230 V AC
(vii) HT connections of RMU through fully insulated cable with termination kits and terminal protector.

Transformer (Type: - Hermetically sealed Corrugation wall)

The distribution transformer shall be 500 KVA three phase Dyn11 vector group oil type with no load ratio of 33000/415 volts with both low and high voltage windings of high purity electrolytic copper. The distribution transformer shall be off load tap switch (-) 5% to (+) 5% in step of 2.5% each steps on HV side. The connections between HT Switchgear and transformer shall be through fully insulated cable with termination kits and terminal protector

LV Switchgear

The LV switchgear shall be provided with Air circuit Breaker on Incomer and MCCBs of suitable rating as outgoing. LV switchgear shall have provision for rear connections through insulated bus bars to transformer LV side. ACB Should be Manually Fix type all Switchgear shall have Ics=100%Icu.

3.4. Earthing (Body Earthing-GI & Transformer Neutral Earthing-Cu.)

Body earthing shall be done with GI bus bar (50X10mm) diagonally and Transformer neutral earthing shall be done with copper bus bar (25X06 mm).

4. Specification of Transformer

1.	Voltage Ratio	33000/415
2.	KVA Rating	500 KVA

3.	Type of construction	Hermetically sealed Oil type
4.	Tapping on	HV off Load – 5% to + 5% @ 2.5% each step
5.	Detail of tank	Material- MS

Thickness of side- 1.2mm corrugated wall. Thickness of bottom/cover- 6 mm.
Tank degree of Protection as IP- 65

6.	Applicable standard	as stated above.
7.	HV Termination	Suitable for XLPE Cable bottom entry
8.	LV Termination	Suitable for connection with LV Switchgear with suitable size busbars.
9.	Fittings	(I) lifting hooks

(ii) Roller (bi-directional)

Winding Temperature indicator with Contacts to be provided for
Alarm & Tripping.

10.	Testing	Routine acceptance test as per IS- 2026 to Be witnessed by representation of engineer- In-charge at his discretion.
11.	Installation	To be installed in enclosure

Power cable from transformer to HV Panel To be provided.

5. Specification for H.V Switchgear

1.	Applicable standard	IS: 13118/IEC 62271-202 (IEC61330) as stated above or Amended up to date
2.	Rating	36KV, 20 kA or higher
3.	Circuit Breaker	SF6 insulated Vacuum circuit breaker for

		Transformer Protection
4.	Operating Mechanism	Manual charging
5.	Tripping arrangement	Shunt trip, series trip with self Powered relay
6.	Bus bar In SF6 Gas insulated tank	Copper bus bar suitable for 630 A
7.	C.T.	Single core for Protection, Cast Resin
8.	Relays & Accessories	Microprocessor based self powered relay for over current and earth fault protection.
9.	Indicating Lamps/Push Button	All standard indicating lamp like phases, ON/OFF breaker charged etc. Heater, Switch etc.
10.	Cable Termination	XLPE HT Cable of size 3C x 185 sq.mm. (Incoming) entry Front side bottom with completely removable doors. Insulated HT cable with termination kits to transformer.
11.	Partial Discharge test	Complete Partial Discharge test on the assembled tank of the RMU.
12.	Internal Arc rating	**20 KA (minimum) for 3 sec or higher for 1 Sec**

6. Design Criteria

Packaged Sub-station consisting of **33KV Non-Extensible SF6 Enclosed Vacuum circuit Breaker Flusarc + Transformer + Low Voltage Switchgear** with all connection accessories, fitting & auxiliary equipment in an Enclosure to supply Low-voltage energy from high-voltage system as detailed in this specification. The complete unit shall be installed on a substation plinth (base) as **Outdoor substation** located at very congested places. 33KV Isolators controls incoming-outgoing feeder cables of the 33KV distribution system. The Vacuum Circuit Breaker shall be used to control and isolate the 33000/415V Distribution transformer. The transformer Low Voltage side shall be connected to Low Voltage switchgear. The connection cables to consumer shall be taken out from the Low Voltage switchgear.

The prefabricated-packaged substation shall be designed for a) Compactness, b) fast installation, c) maintenance free operation, d) safety for worker/operator & public.

The Switchgear and component thereof shall be capable of withstanding the mechanical and thermal stresses of short circuit listed in ratings and requirements clause without any damage or deterioration of the materials.

For continues operation at specified ratings temperature rise of the various switchgear components shall be limited to permissible values stipulated in the relevant standard and / or this specification.

Service Conditions:

The Packaged substation shall be suitable for continuous operation under the basic service conditions indicated below.

The climatic conditions in the area are as follows.

Maximum temperature in shade	50°C
Minimum temperature in shade	-5°C
Altitude above mean sea level	1500 m
Relative Humidity	90%
Seismic zone	V

The Enclosure of High Voltage switchgear-control gear, Low Voltage switchgear- control gear & Transformer of the packaged substation shall be designed to be used under **normal outdoor service condition** as mentioned. The enclosure should take minimum space for the installation including the space required for approaching various doors & equipment inside.

7. **Specific Requirement**

1.1 The main components of a prefabricated- packaged substation are Transformer, High-voltage switchgear-control gear, Low-voltage switchgear-control gear and corresponding interconnections (cable, flexible , bus bars) & auxiliary equipment. The components shall be enclosed, by either common enclosure or by an assembly of enclosure. All the components shall comply with their relevant IEC standards.

7.2 **Ratings:**

Description	Unit	Value
Rated Voltage / Operating Voltage	kV	36/33
Rated frequency & Number of phases	Hz & nos.	50 & 3
Rated maximum power of substation	kVA	500 kVA
Rated Ingress protection class of Enclosure	IP:	IP-23D (min) or higher for Transformer compartment and IP:54D for LT Switchgear & HT Switchgear enclosure
Rated temp Class of Transformer, Compartment		K10
HV Insulation Level		
Rated withstand voltage at power frequency of 50 Hz	kV rms	70
Rated Impulse withstand Voltage	kV peak	170
HV Network & Busbar		
Rated current	Amp	630A
Rated short time withstand current	kA rms / 1sec	20 kA for 3 sec or higher for 1 sec
Making capacity for switch- disconnector & earthing switches	kA peak	52 kA
LV Network/300KVAR APFC Panel		**FOR 500 KVA** – As stated above

8. **Outdoor Enclosure**

The enclosure shall be made of 2MM CRCA/GI tropicalised to local weatherconditions. The metal base shall ensure rigidity for easy transport & installation.

The protection degree of the Enclosure shall be **IP54D for LT & HT switchgear compartment & IP 23 or 34D or higher for Transformer compartment.** Proper / adequate ventilation aperture shall be provided for natural ventilation by way of Louvers etc. **Roof should be slant to avoid any type of water/ice logging.**

The transformer door shall be provided with proper interlocking arrangement for safety of operator.

The H.V. & L.V. outgoing of the transformer are to be connected to Vacuum Circuit Breaker of Flus arc & incomer of the Low Voltage Switchgear by means of Cables / Flexible Busbars,

Internal Fault: Failure within the packaged substation due to a defect, an exceptional service condition or mal-operation may initiate an internal arc. Such an event may lead to the risk of injury, if persons are present. It is desirable that the highest practicable degree of protection to persons shall be provided. **PSS should have been tested to sustain an Internal Arc of 20KA for 3 sec or higher for 1 second in case of any fault condition.** The Internal Arc Design shall be tested as per IEC 61330 & 62271-202.

Covers & Doors: Covers & doors are part of the enclosure. When they are closed, they shall provide the degree of protection specified for the enclosure. Ventilation openings shall be so arranged or shielded that same degree of protection as specified for enclosure is obtained. Additional wire mesh may be used with proper Danger board for safety of the operator. All covers, doors or roof shall be provided with locking facility or it shall not be possible to open or remove them before doors used for normal operation have been opened. The doors shall open outward at an angle of at least 90° & be equipped with a device able to maintain them in an open position.

Earthing: All metallic components shall be earthed to a common earthing point through (50X10 mm) GI strips. It shall be terminated by an adequate terminal intended for connection to the earth system of the installation, by way of flexible jumpers/strips & Lug arrangement. The continuity of the earth system shall be ensured taking into account the thermal & mechanical stresses caused by the current it may have to carry. The components to be connected to the earth system shall include :

a) The enclosure of Packaged substation,
b) The enclosure of High voltage switchgear & control gear from the terminal

provided for the purpose,

c) The metal screen & the high voltage cable earth conductor,
d) The transformer tank or metal frame of transformer,
e) The frame &/or enclosure of low voltage switchgear,

There shall be an arrangement for internal lighting activated by associated switch for HV, Transformer & LV compartments separately.

Labels: Labels for warning, manufacturer's operating instructions etc. shall be durable & clearly legible.

Cleaning & Painting :

The paints shall be carefully selected to withstand tropical heat and rain. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling. All sheet steel work shall be phosphatized in accordance with the following procedure and in accordance with relevant IEC/IS 6005 Code of practice for phosphatizing iron and steel.

All grease, dirt and swraf shall be thoroughly removed by brush cleaning with water and sodium carbonate.

Rust and scale shall be removed by pickling with diluted acid followed by washing with running water, finishing with slightly alkaline hot water and drying.

After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and drying.

The phosphate coating shall be sealed with the application of two coats of ready mixed stoving type zinc chromate primer. The first coat may be flush dried while the second coat shall be stoved.

After application of the primer, two coats of finishing synthetic enamel paint of reputed make shall be applied, each coat followed by stoving. The second finishing coat shall be applied after completion of tests. The colour for the finishing paint shall be light gray as per shade no. 631 of IS: 5 or other equivalent standard shade. Each coat of primer and finishing paint shall be with slightly different shade to enable inspection of the painting.

The finishing painted surface of switchboards shall present aesthetically pleasing appearance free form dents and uneven surface.

The inside surfaces of the switchboard shall be painted white.

8. **33KV Non-Ext SF6 Enclosed Compact Vacuum Circuit Breaker**

33KV Non-Ext SF6 Enclosed with Compact VCB: The requirement of 33kV Compact VCB

is as under:

SF6 Gas filled Non-extensible Compact Vacuum Circuit Breaker comprising of 3 panels as indicated below:

Panel No. 1: One no. 630A Manually Fix Isolator as **Incomer with** complete operating mechanism, protection system and cable box accessible from the front.
Panel No. 2: One No. 630A manually Fix Vacuum Circuit Breaker as outgoing tee off to transformer with complete operating mechanism, protection system and cable box accessible from the front.
Panel No.3: One no. 630A Manually Fix Isolator as interconnection to next PSS with complete operating mechanism and cable box accessible from the front.

The above Isolators, breakers, Bus bars should be mounted inside a TIG (Tungsten Inert Gas) welded sealed for life, stainless steel tank of 2 mm thick sheet metal. The tank should be filled with SF6 gas at adequate pressure. The degree of protection for gas tank should be IP65, leak rate of SF6 gas less than 0.1% and tested as per IEC 60056/60694/60298.

The Vacuum Circuit Breaker is required to control 33000/415 volts distribution Transformer of rating 500KVA and relay settings shall be selected accordingly.

General Finish: Totally enclosed, metal clad, vermin and dust proof suitable for tropical climate use as detailed in the specification.

Ratings: The bus bars shall have continuous rating of 800 Amps. The isolator shall have a continuous rating of 630 Amps; Vacuum Circuit Breaker shall have a continuous rating of 630 Amps. in accordance with relevant IEC standard

Breaking & Making Capacity: The isolators shall be capable for breaking rated full load current. Vacuum Circuit Breaker shall be capable of having rupturing capacity of 20kA for 3 sec or higher symmetrical at 33KV.

Bus bar: Switchgear shall be complete with all connection, bus-bars etc. tinned Copper bus bars continuous rating shall be 800 Amps. The bus bars should be fully encapsulated by SF6 gas inside the steel tank.

Remote Operation: Provision to be provided for Remote operation of the Flusarc's Isolators (L) & Breaker (CB) using Motors fitted to the operating mechanism if required. It should be made possible to fit the motors either directly in manufacturing plant or on site as & when required.

Isolator :

The Isolators offered shall conform to IEC60129. The isolator shall be triple pole, spring assisted, hand operated, non-automatic type with quick break contacts. The operating handle shall have three positions 'ON', 'OFF' and 'EARTH' which shall be clearly marked with suitable arrangement to padlock in any position. A safety arrangement for locking shall be provided by which the isolator operation shall be prevented from 'ON' position to 'EARTH' position or vice versa in a single operation.

9. **Switchgear:**

The Compact Switchgear shall be Sealed for life, the enclosure shall meet the "sealed pressure system" criteria in accordance with IEC: 298 (a system for which no handling of gas is required throughout service life of approximate 25 years.) There shall be no requirement to 'top up' the SF6 gas. In addition, manufacturer shall confirm that maximum leakage rate is lower than 0.1% per year. It shall provide full insulation, making the switchgear insensitive to the environment. Thus assembled, the active parts of the switchgear unit shall be maintenance free.

The switchgear & switchboard shall be designed so that the position of different devices is visible to the operator on the front of the switchboard & operations are visible as well. The switchboard shall be designed so as to prevent access to all live parts during operation without the use of tools.

Flusarc should be tested for internal arc fault test.

10. **Vacuum Circuit Breaker:**

The Unit shall consist 630A/250A Tee-off spring assisted three position , three pole Vacuum circuit breaker, with integral fault making / dead breaking earth switch. The function shall be naturally interlocked to prevent the main & earth switch from being switched 'ON' at the same time & the CB not allowed to trip in 'Earth On' position. The selection of the main/earth switch lever on the panel, which is allowed to move only if the main or earth switches in the off position. The lever shall be able to pad locked in either the main or earth position.

The manual operation of the circuit breaker shall not have an effect on the trip spring. This should only be discharged under a fault (electrical) trip condition; the following manual reset operation should recharge the trip spring & reset the CB mechanism in 'main off' position.

Protection: Protection Relays: The CB shall be fitted with microprocessor based self powered relay inside the front cover to avoid any tampering. The relay should be 3 Over Current + 1 Earth Fault, self powered type, fed by protection CT's mounted in the cable box.

Cable Box:

Every isolator shall be provided with suitable and identical cable boxes in front for connecting 3 core, 33kV cable from vertically below. The cable boxes shall be so located at convenient height to facilitate easy cable jointing work.

Locking Arrangement: Suitable padlocking arrangements shall be provided as stated below;

a) CB manual operating handle in the "OFF" position.
b) Each feeder Panel operating handles in 'Closed' 'Open" or 'Earth' position.
c) Each isolator operating handle in 'Closed', ' Open', or 'Earth' position.

Ratings :

		Non-Extensible Compact SF6 Enclosed VCB
	Switchgear Data	
a)	Service	Outdoor but inside Enclosure
b)	Type	Metal clad
c)	Number of phases	3
d)	Voltage	33000V
e)	Rated Frequency	50 Hz
f)	Rated Current	630 Amp (isolator)

g)	Short Circuit rating	
	i) Breaking	20 kA rms for Breaker
	ii) Short time withstand for 1 Sec.	20 kA rms
	iii) Rated S/c making	50 kA peak for Breaker
h)	Short duration power freq.	70 kV rms

i)	Insulation Level	170 KV peak
j)	System earthing	Solidly earthed at substation
	Breaker	
a)	Type	VCB in SF6 tank
b)	Rated voltage	33kV
c)	Breaking current	
	i) Load breaking	20 KA rms.
d)	Making current	52.5 KA peak
e)	Rated current	630 Amps.
f)	No. of poles	3
g)	Operating mechanism.	Trip free & free handle type with mechanically operated indication & pad locking.
	Isolators	
a)	Type	**Load breaking and fault making in SF6 tank**
b)	**Rated current**	630 Amps.
d)	Rated breaking capacity	630 Amps.
e)	**Fault making capacity**	52 KA peak

f)	**No. of poles**	3
g)	**Operating mechanism**	Operating handle with ON, OFF, Earth positions with arrangement for padlocking in each position.
	Busbars: (If any)	
a)	Material	Aluminum/Copper

b)	Type	SF6 insulated
c)	Rated Current	865 Amps
d)	Short time rating for 3 Sec.	-

11. Tests For RMU:

Each type of 33kV Switchgear shall be completely assembled, wired, adjusted and tested at the factory as per IEC:265, IEC:298.

Routine Tests: The tests shall include but not necessarily limited to the following:

a) Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme and proper functioning of the equipment.
b) All wiring and current carrying part shall be given appropriate High Voltage test.

12. Distribution Transformer (Type: - Hermetically sealed Corrugation wall)

Requirement: 33000/415 Volt Oil immersed, 500 KVA ONAN cooled suitable for installation at outdoor in Enclosure for ground mounting.

Voltage Ratio: No load voltage 33000/415 volts within tolerance as stipulated in IEC.

Rating: The transformer shall have a continuous rating as specified at any of the specified tapping position and with the maximum temperature rise specified.

Temperature Rise: The maximum temperature rise at the specified maximum continuous output shall not exceed 40°C by thermometer in the hottest portion of the oil or 50°C measured by resistance of winding above ambient temperature, not exceeding 40°C daily average or 50°C maximum.

Connections: H.V. Delta and L.V Star connected with neutral brought out on the secondary side for connection to earth; Vector group DYn11.

13.5.1 **Tapping :**

Each transformer shall be provided with **Rotary/Linear type tap switch** so as to provided for a voltage adjustment on H.V. from +5% to –5% of rated voltage of 33000 volts in 4 equal steps (5 position) to obtain rated voltage of 415 volts on LV side. Refer clause no:4.5.4 for details of rotary switch. The tapping shall be provided for following voltage ratios at no load.

Cleaning & Painting :

a) All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents, as required to produce a smooth surface free of scales, grease and rust.
b) The internal surfaces in contact with insulating oil shall be painted with heat resistant insulation paint which shall not react & be soluble in the insulating liquid used.
c) The external Surfaces, after cleaning, shall be given two coats of high quality epoxy based rust resisting primer followed by filler coats.
d) The transformer shall be furnished with coats of weather resisting battleship gray epoxy based enamel paint specially recommended for transformer use.
e) The paints shall be carefully selected to withstand tropical heat rain, effect of proximity to the sea etc. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.
f) Special care shall be taken by the manufacturer to ensure against rusting of nuts, bolts and fittings during operation. All bushings and current carrying parts shall be cleaned properly after final painting.

Both H.V. and L.V. bushings shall have suitable creepage distance as per IEC/IS.

Oil: New transformer oil used shall be according to relevant IEC standards

Phase Marking & Danger Plate: Phase markings in fluorescent paint on small non-corrodible metallic tags shall be permanently fixed for H.V. and L.V sides. Phase markings tags shall be properly fixed with proper alignment. Danger plates shall be provided on the H.V & LV sides, mentioning the Corresponding Voltages.

Core and Coil :

Core: The core shall be constructed from high grade, cold rolled, non-ageing, low loss, high permeability, grain oriented, cold-rolled grain oriented silicon steel laminations. The transformer shall be so designed as to have minimum humming noise. The percentage harmonic potentials with the maximum flux density under any conditions shall be such that capacitors connected in the system shall not be overloaded.

The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer. The core and coil assembly shall be capable of withstanding without injury, the thermal and mechanical effects of short circuit at the terminals of any winding.

Noise: The Contractor shall take special precautions to ensure that the noise and vibration level does not exceed which is obtained in good modern practice.

Impedance Volts: The Percentage impedance value at 75° C at any tap shall be 4 % for 500 KVA subject to tolerance as specified in relevant IEC standards. The value of the

impedance volts at each tapping over the specified range shall be specified in the bid.

Regulation: The regulation at 75° C Cat full load at unity and 0.8 power factor subject to the usual tolerance as per IEC standards shall be specified in the bid.

Power Freq. High Voltage & Insulation Level (Impulse voltage): The distribution transformer shall be designed so that they are capable of withstanding high voltage & impulse voltages as given below:

a) Impulse Voltage for 33kV winding: 170 kV (1.2/50 Microsecond wave shape).
b) High Voltage: 70kV rms.

13. RATINGS (Summary):

	Application	500 kVA Corrugated Tank
1	Service	Outdoor in an Enclosure, Step down
2	Type	Oil immersed corrugated tank
3	Cooling system	ONAN
4	No. of Phases	3
5	No. of winding per phase	2
6	Rated output (MVA) With ONAN cooling	HV / LV HV-1 LV-1
7	Rated voltage in KV (Line to Line)	HV-33 kV LV-0.415 kV
8	Rated frequency	50 Hz
9	Temperature rise above 50°C	
A	In winding by resistance	50°C or above
B	In Oil by thermometer	40°C or above
10	Guaranteed losses at 75°C and at normal tap position without any positive tolerance	
		500 KVA
A	No Load loss (W)	900 W (with IS Tol.) as per IS 2026
B	Full Load loss (W)	5000W (with IS Tol.)
C	Total loss (W)	14000W (with IS Tol.)
11	Insulation level	
A	H.V. Power Freq. KV rms	70 kV
B	H.V. (kVpeak) Impulse	170 kV

C	L.V. (kV)	-
12	Vector Group	Dyn11
13	Parallel operation	Yes
14	Type of taps provided	Off Load full capacity
A	Taps provided on	H.V. winding
B	Range of taps	±5% in steps of 2.5% (4 steps, 5 position)

C	Method of Tap Change control	Rotary Switch
D	Manual load	Yes 'Off Circuit'
15	Percentage impedance at 75 Deg. C	4 %
16	System earthing	
A	H.V.	Solidly earthed
B	L.V.	Solidly earthed
17	Terminal arrangement	
A	H.V.	From H.V. Bushing on Top.
B	L.V.	From L.V. Bushing on Top.
C	L.V. Neutral	From L.V. Neutral Bushing on Top.
18	Transformer-bushing voltage class a) H.V. (kV) b) L.V. (kV)	 36 kV class 1.1kV class
19	System fault level a) H.V. side b) L.V. side	 - -

20	Short circuit withstand capability duration	3 sec.
21	L.T.side C.T. ratings	
A	Current Ratio	50/1A
B	Class of Accuracy	1.0
C	Burden	2.5 VA
D	Type	Resin cast ring type

14. L.T. Panel as per the standard System:-

a) **Declared voltage** :– 3 Phase, 4 Wire, 415V (±6%) 50 Hz,

b) **Neutral:** – Solidly earthed at substation.

General finish: - Tropical, totally enclosed, metal-clad, weather-proof, vermin and dust proof.

14.3 **Construction :**

Enclosure: - Dead Front type of enclosure shall be able to provide the degree of Protection IP:65.

L.T. SWITCHBOARDS

1.0 **SCOPE**

This specification covers the design, manufacture, shop testing, packing, supply, delivery and storage at site erection, testing and commissioning of indoor 3- Phase , 4- wire, 415 V, 50 HZ. neutral solidly grounded LT switchboards complete in all respects including hardware housed in factory assembled packaged Distribution sub-stations (PSS) proposed for BHU in New Doksum Integrated township in Bhutan.

2.0 **STANDARDS**

2.1 The equipment covered in these specifications shall conform to the following Indian Standard Specifications

IS: 5	Colours for ready mixed paints & enamels
IS: 722	AC Electricity Meters
IS: 1248	Direct acting indicating analogue electrical measuring instruments and their accessories
IS: 1554	PVC insulated (heavy duty) electric cables
IS: 2147	Degrees of protection provided by enclosures for Low-voltage switchgear and control gear
IS: 2419	Dimensions for panel mounted electrical indicating & recording electrical instrument
IS: 2551	Danger notice plates
IS:2633	Methods for testing uniformity of coating of Zinc coated articles.
IS: 2705	Current Transformers
IS: 3156	Voltage transformers

IS: 3231	Specification for electrical relays for power system protection
IS:4237	General requirements for Switchgear & Control gear for voltage not exceeding 1000 volts.
IS: 4794	Push buttons
IS: 5082	Wrought aluminum and aluminum alloy bars rods, tubes, sections plates, sheets for electrical application
IS: 5578	Guide for making of insulated conductors
IS: 6005	Code of practice for phosphate coatings of iron and steel (first revision).
IS: 6875	Control switches (switching devices for control and auxiliary circuit including contactor relays) for voltages up to and including 1000 V AC and 1200 V DC
IS: 8623	Low voltage Switchgear and Control gear assemblies.
IS: 8828	Electrical accessories circuit breakers for over current protection for home load and similar installations.
IS: 9000	Basic environmental testing procedures for electronic and electrical items.
IS: 10580	Service conditions for electrical equipment
IS: 11353	Guide for uniform system of marking and identification of conductors & apparatus terminals.
IS: 13703	Low voltage fuses for voltages not exceeding 1000 V AC or 1500 V DC
IS: 13942	Low voltage switchgear and control gear.
SP: 39-1987	Guide for insulation coordination within low voltage system.
IEC: 664 A	Insulation coordination within low voltage system including clearance and creepage distance for equipment.

One set of above IS/IEC Specifications and any other standard adopted for this work shall be supplied free of cost by the successful bidder during detailed engineering.

2.2 The equipment complying with other internationally accepted standards shall also be considered, if they ensure performance equivalent to or superior to Indian Standards.

3.0 SYSTEM DETAILS

The LT Distribution Board shall be a part of a packaged substation (PSS). Broadly the LT distribution board shall have the following configuration.

i) **Connection to LV side of Transformer**

Connection to LV side of 500 kVA, 33000/415V transformer shall be through insulated tinned Copper bus bars may be considered with a non-segregated three phase four wire bus duct, conforming to relevant IS Standard.

ii) **Incomer**

The LT board shall have a 800 A, 50 kA for 1 sec. electrically operated, Air Circuit Breaker complete with CTs & metering.

iii) **Bus Bars**

1200A ,50 kA three-phase four wire tinned copper non-segregated bus bars shall be provided.

iv) **Outgoing Feeders**

(a) No HRC fuses are envisaged. The outgoing feeders shall be equipped with Moulded Case Circuit Breakers/MCB of appropriate rating with rotary switches. The interlinking MCCBs/MCB connecting LT bus-bars of transformers shall be manual operated. The LT bus bar of packaged sub-station No. 2, 3, 4 and 5 shall be inter-linked with 1250 A, 4 pole MCCBs.

(b) The number and rating of 6 outgoing LT feeder from each PSS shall be as indicated in SLD enclosed.

v) External Cabling

The external LT (three phase, four core) duly supported cables shall be terminated to the outgoing feeder points from the LT switch board.

4.0 CLIMATIC CONDITIONS

The climatic conditions in the area are as follows.

Maximum temperature in shade	40°C
Minimum temperature in shade	-5°C

Altitude above mean sea level	1500 m
Relative Humidity	90%
Seismic zone	V

5.0 AMBIENT CONDITIONS FOR DESIGN

The equipment shall be designed considering the following

Ambient temperature	40° C
Relative Humidity (condensing type)	90%
Altitude	1500 m
Minimum temperature	-5° C

Important

While designing the equipment the Contractor must take into account the adverse conditions prevailing at site especially with condensing type humidity low temperature, high altitude, high rainfall, (causing quick rusting of steel parts), foggy atmosphere and presence of leaches, reptiles and flying insects.

6.0 QUALITY CONTROL

All material shall be new and of best quality and of class, most suitable for working under the conditions specified herein without distortion or deterioration of equipment during the lifetime of not less than twenty five years.

7.0 DESIGN AND STANDARDIZATION

7.1 General

(i) The equipment shall be designed to ensure satisfactory operation of the system in which continuity of service is the first consideration and shall also be designed to withstand sudden load variations due to short circuits and fault conditions or for any other reason. The design shall incorporate every reasonable precautions and shall have necessary provision for the safety of all those concerned in the operation and maintenance of the LT switchboard as a part of the package substation.

(ii) All mechanism shall be made of such materials as to prevent sluggishness due to rust or corrosion. All connections and contacts shall be of ample section and have sufficient surface area for carrying continuously the specified current without undue heating and

shall be secured rigidly and locked in position. Standard sizes of bolts, screws, pipes and other fittings are to be used and number of sizes is to be kept to the minimum.

(iii) Cast Iron shall not be used for any part of the equipment, which may be subjected to mechanical stresses.

(iv) All apparatus shall be so designed and constructed as to obviate the risks of short circuits of the live parts by lizards etc. Metal cubicles, housing and covers shall be 100% weather/vermin proof and shall be able to provide the degree of protection IP 65 in accordance with latest version of IS/IEC.

(v) All parts shall be manufactured in accordance with relevant standard specifications of IEC/I.S.S. Corresponding parts of similar equipment and apparatus shall be mutually interchangeable.

(vi) All apparatus, connections and cabling shall be designed and arranged to minimize the risk of fire and any damage which might be caused in the event of fire.

7.2 Specific Technical Particulars

The standard technical particulars (which must be modified considering the altitude of operations as given in relevant standards) for the LT switchboard are given below:

1.	**AC System**		:	3 phase,4 wire, solidly earthed
	i)	Voltage	:	415 volts -6 to + 9 %
	ii)	Frequency	:	50 Hz ± 3 %
	iii)	Combined variation in voltage & frequency	:	- 15 % to + 10 %
2.	**Bus Bar**			
	i)	Continuous rating	:	1200 A (of Tinned Copper)
	ii)	Short time (1 Sec)	:	50 kA rms

3. **One Minute Power Frequency Withstand Voltage**

(Under standard conditions to be enhanced as per relevant IS/IEC corresponding to design altitude of 1500 m)

i)	Power circuits		:	2.5 kV (rms)
ii)	Control circuits		:	2.5 kV (rms)

iii)	Basic Insulation Level	:	As per Standard	

4. **Moulded Case Circuit Breaker (MCCB, 4 pole) with Rotary handle**

i)	Voltage	AC 3- phases, 415 V (-6 to + 9 %)
ii)	Frequency	50 Hz
iii)	Short circuit Performance	P_2
iv)	Short-circuit Capability	50 k A (rms) for 1 Sec.
v)	Making capacity	2.5 times breaking capacity
vi)	Operating Mechanism	Manual , trip free
vii)	Temperature rise	As per IS: 2516
viii)	Mechanical	As per IS: 2516
ix)	Auxiliary contacts	4 NO., 4 NC
x)	Current Rating	As per Single Line Drawing

5. **Meters**

i)	Accuracy class	:	1.5 or better for indicating & 1 or better for energy & power meters
ii)	One Minute Power	:	2 kV (rms)

Frequency Withstand Voltage

6. **Current Transformers**

i)	Type	:	Cast resin, Bar primary
ii)	Secondary circuit	:	5 Amp.
iii)	Voltage class and Frequency	:	1100 v , 50 Hz
iv)	Class of insulation	:	E or better
v)	Accuracy	:	
a)	Accuracy class & VA of metering CT	:	Class 1, 10 VA
b)	Accuracy class of VA of protection CT	:	5 P 15 , 10 VA
vi)	Short time current rating	:	50 kA (rms) for 1 sec.
vii)	Dynamic rating	:	120 kA (peak)
viii)	One Minute Power Frequency Withstand Voltage	:	2.5 kV (rms)

7. **Voltage Transformers**

i)	Type	:	Cast resin
ii)	Rated voltage	:	
a)	Primary	:	415 V/ √3
b)	Secondary	:	110 V/√3
iii)	Accuracy class and VA burden		

a)	Metering	:		1.0, 50 VA
b)	Protection	:		3 P, 50 VA
iv)	Method of connection			
a)	Primary	:		Star
b)	Secondary	:		Star
v)	Rated voltage factor	:		1.1 continuous , 1.5 for 3 sec.
vi)	Class of insulation	:		E or better
vii)	One minute power frequency withstand voltage	:		2.5 kV (rms)

8. **Relay**

i)	One Minute Power Frequency Withstand Voltage	:	2.0 kV (rms)

9. **Cubicle Colour Finish**

i)	Interior	:	Glossy white
ii)	Exterior	:	Grey shade No. 631 of IS : 5

10. **Accessories**

i) Plug point with switch fuse.
ii) Space heater with thermostat.
iii) Name plate on front & rear.
iv) Danger plates.

11. **Enclosure**

i)	Minimum thickness of CRCA sheet steel	2 mm
ii)	Base Frame channel	100mmx50mmx6 mm

iii) Degree of protection IP-54.

iv) Synthetic insulating Mats 8 mm

Panel & base

7.3 Clearance And Creepage Distances

The clearances and creepage distances shall be in accordance with IS: 13947 (updated) and corrected for operation at a design altitude of 1500 m as per (Bureau of Indian Standards) SP: 39-1987 and IEC: 664 A-1980 for most polluted area.

7.4 Labels And Marking Of Connections

All equipment, control gear and the apparatus mounted thereon shall be clearly labelled indicating, their purpose and the 'ON' 'OFF' and 'EARTH' positions. The labels shall be clearly lettered on enamelled surface or other approved materials. Brass should not be used for labels. Each phase of alternating current and connections shall be coloured to distinguish phase, neutral and earth. The colouring shall be red, yellow, blue for phases black for neutral and green for earth.
Each phase of alternating current and connections shall have coloured heat shrinkable sleeve as suggested. The LT switchboards shall be labelled as per designation shown in the single line

diagram. The labelling shall be finalised after the samples and arrangement for the same, is to be approved by the successful bidder during detailed engineering.

8.0 DRAWINGS AND LITERATURE

Six sets of tentative G.A, schematic drawings and detailed literature of equipment shall be submitted with the tender clearly giving the scope of supply and bill of material to enable the purchaser to scrutinize all aspects of design including arrangement and support of cable accessibility for maintenance work and future additions, cable connections, general appearance etc.

Further sets of drawings & literatures are to be furnished by successful tenderer/bidder within 2 weeks after the award of contract by the purchaser, which shall include the following:

(i) Complete assembly drawings of the boards, showing plan, elevation, typical section and location of terminal blocks for external wiring connections and mounting details of various devices with dimension.
(ii) Foundation plan showing embedment channel frame in the floor with associated holes and suitable size of bolts for fixing to channel frame of feeder pillars.
(iii) Wiring diagrams including terminal wiring design and cable schedule.

(iv) Schematic control diagram for controls, relays, instruments, space heaters, cubicle illumination and receptacle etc.

(v) Detailed bill of material of each LT board.

(vi) Layout plan of each LT board.

9.0 BOUGHT OUT ITEMS

All bought out items such as switches, MCCBs, MCB's meters, terminals, cables etc. shall be of reputed make. Purchaser reserves the right to accept only materials of proven make at its sole discretion.

10.0 SPECIFICATION OF L.T. SWITCHBOARDS

10.1 Constructional Details

(i) The switchboards shall be made of cold rolled sheet steel of 2 mm having different compartments for bus-bars, cable alley and instrumentation. The board shall be floor mounted & self supporting.

(ii) The bus-bars shall rectangular and electrolytic copper and of approved size for current rating of 1200 Amps for phases as well as for neutral. The bus bars shall be suitably supported on non-hygroscopic insulators to withstand forces arising from short circuits in the system.

(iii) It will have to be particularly ensured by the bidders that all off load isolating switch 4 pole from the bus bars to the circuit breaker/switches shall have adequate short circuit withstand capacity. The bus-bars shall have three separate sections & cross section of the bus-bars in each section shall be the same. The bus-bars sections shall be joined together by providing by two number four pole, off circuit off load isolating switches and each switch is to be operated by a common handle located at a convenient position. The rating of the link switches shall match with the rating of the bus-bars. By opening the 4 pole off load isolating switches, it should be possible to operate the bus-bars into three different sections.

(iv) The switch boards shall be of compact design. All doors and covers shall be fully gasketted with rubber. Individual feeder compartments shall be provided with hinged doors, bolted type doors shall not be acceptable. Indicating instruments shall be of 100x100 mm.

(v) Suitable off-circuit 4 way links of current ratings of 320 & 400 Amps for the feeders and 800 Amps for the LT inter-connection with other substation shall be provided in the LT switchboard for connecting the outgoing LT feeders and the links shall be suitable for connecting aluminum armoured cable on the outgoing side. The MCCB & the links shall be solidity connected and size of the connecting leads shall be suitable for 400 A/1250 Amps for feeders & interconnecter /Isolaters respectively as indicated in the SLD. The outgoing side of the links shall be provided with lugs for connecting the outgoing feeder cables suitable for 400/800 Amps currents for feeders & interconnection.

(vi) The interconnections between bus-bars and MCCBs unit shall be solid insulated, tinned copper strip permanently bolted with the bus-bars and MCCBs. The bus-bar joints shall be given a thin coating of conducting grease after fully cleaning both the surfaces. The terminals shall be of substantial mechanical strength & shall provide adequate electrical contact area and the contact pressure is maintained permanently. The bus-bars/tee off shall be insulated with heat shrinkable sleeve tapes with red, yellow, blue colours for 3 phases and black for neutral. All the bus-bar tapping & markings shall be in accordance with relevant IS.

(vii) The gland plate shall be of thickness 3.15 mm and detachable type. All the cable brass glands shall the chrome plated and double compression type and shall be supplied with the LT switchboards for XLPE armoured cables.

(viii) A strong supporting channel & 100 x 50 x 6mm shall be provided beneath the switchboard besides anti vibration rubber gasket of 15 mm thickness.

(ix) Ammeter with selector switch & CTs, voltmeter with selector switch and KVA, KW & PF shall be provided on the incomer from the transformer to the LT switchboards. Similarly ammeter with selector switch & CTs shall be provided on all the outgoing LT feeders.

(x) The connection from the transformers to the LT switchboard shall be through a LT non-segregated bus duct or through insulated copper bus bars.

(xi) The 1200 Amps bus-bars, shall have non-hygroscopic support insulators. The bus bar shall be insulated with heat shrinkable insulating kits.

(xii) The short circuit withstand capacity of all the bus-bars and tap-connection shall be 50 KA for one second.

(xiii) Doors at the rear of the switchboards shall also be provided to facilitate maintenance works. It shall also bear the name of feeder.

Above arrangement shall be got approved by bidder prior to fabrication.

10.2 AIR CIRCUIT BREAKER (ACB)

415 V four pole air circuit breakers shall be withdrawal type with manually and electrically operated mechanism. It shall be supplied for controlling the LV side of the 33/0.415 kV, 500KVA distribution transformers. Air circuit breakers shall have symmetrical short circuit rating of 50 kA for 1 sec. The short circuit mechanism and breaking capacities should be supported by test certificates. The circuit breaker shall be fitted with direct acting LT operated thermo magnetic release and shall be independently adjustable.

It shall be provided with instantaneous adjustable short circuit trip. The adjustment of the setting should be possible without disrupting the supply. The releases shall be ambient temperature compensated type. The thermal setting should be continuously adjustable. The time delay in the magnetic trip shall be obtained by mechanical means which would be rugged and non-ageing type and should be clearly shown. The breaker mechanism should be robust, quick making quick breaking and trip free. It should be possible to close and trip the breaker without opening the

compartment & door.

The detailed specifications of Air Circuit Breaker shall be as under:

(i)	No. of poles	Four
(ii)	Service voltage	415 Volts
(iii)	Normal current	800 Amps
(iv)	Frequency	50 Hz
(v)	Rated Symmetrical Breaking Capacity at 415 V AC/50Hz	50 kA for 1 Sec.
(vi)	Making current	120 kA
(vii)	Rated insulation voltage	1000 V
(viii)	Breaking time	30 ms
(ix)	Making time	40 ms

10.3 LT MOULDED CASE CIRCUIT BREAKER

(i) All the LT outgoing underground feeders from the sub-station shall be controlled by moulded case circuit breakers, provided in the LT switchboard.

(ii) The moulded case circuit breakers shall be of a robust construction and shall comprise of a switching mechanism, contact system, arc extinguishing device and a tripping unit contained in a compact moulded case and cover. The insulating case and cover shall be made of high strength, heat-resistant and flame-retardant thermo-setting insulating material.

(iii) The switching mechanism shall be quick-make/quick break type, and should be trip-free.

(iv) The arc extinguishing device shall comprise of a series of grid plates mounted in parallel between supports of insulating material. The arc shall be drawn from the moving contact into the divide chamber and extinguished.

(v) The moulded case circuit breakers shall have a thermo-magnetic type tripping mechanism, where the heating effect and the electromagnetic effect of current are made use of to provide protection against overload and short-circuit conditions respectively. The heated-bimetal strip in each phase of the MCCB shall actuate the tripping system following on inverse-time-current characteristics depending upon the severity of the overload current. During short-circuits, the system shall trip instantaneously. The tripping element provided on each pole of the MCCB shall operate on a common trip bar, thereby preventing single phasing in the event of fault occurring on any of the phases. The tripping device shall be ambient temperature compensated type.

(vi) The MCCB shall have a minimum rupturing capacity of 50kA. Positive indication about the position of the MCCB i.e. whether 'ON' 'OFF' or TRIPPED shall be provided .Rotary operating handle shall be provided for drive.

(vii) The short circuit breaking capacity and operation mechanism of the MCCB shall be supported by test certificates.

(viii) All the MCCBs used in LT switchboards for controlling the outgoing LT feeders shall have a current setting of 50 to 100% of its rated current.

The rated currents given are provisional and shall be finalised during detailed engineering.

(ix) The detailed specifications of the MCCBs shall be as under:

(a) No. of poles	4 pole
(b) Service voltage	415 Volts
(c) Normal current	standard rating as per SLD.
(d) Frequency	50 Hz
(e) Breaking capacity	50 kA
at 415 V ac, 50 Hz	
(f) Short time current rating for 1 sec	50 kA
(g) Making current	120kA

(x) MCCB shall be provided with rotary handles

11.4 MOULDED CASE CIRCUIT BREAKER (MCCB)

The outgoing underground feeders/service lines from the LT feeder pillars shall be controlled by MCCBs. It shall provide protection against over loads and short circuit.

The MCCBs shall be of robust construction with insulating case made of self extinguishing, thermoplastic material. The switching mechanism shall be quick make/quick break and shall be trip free.

The details specification of the MCCBs shall be as under:

1.	No. of poles	4 and 2 poles as required
2.	Service voltage	415/240 volts
3.	Normal current	Rating shown in SLD
4.	Frequency	50 Hz.
5.	Breaking capacity	50 kA

11.5 ACB CONNECTION TO TRANSFORMER

The air circuit breakers shall have earth terminals and suitably earthed with the main earth bus. The air circuit breakers of the LT board shall be connected to the LT side of the 500 kVA distribution transformers. In case non-segregated bus duct is provided the connections at both the ends shall be through proper clamps preferably bimetallic. Suitable bellows shall be provided in the bus duct to take care of the expansion.

11.6 TERMINATIONS OF INCOMING AND OUT GOING CIRCUITS

The cable termination arrangements shall be located at the lowest point of the disconnecting link, just above the cable clamps, for ease of termination. It shall be suitable for accommodating up to and including 240 sq mm XLPE armoured cable with either sweated lugs or compression lugs.

Cable support shall be provided by a suitable clamp at the bottom of the structure in such a manner that the cable entry to the distribution boards sealed by the gland and that the cable is clear of main metalwork. These cable supports shall be adequate to support the outgoing cable in normal services and when subjected to the short circuit current specified. The distance between these cable supports and the ground level shall be at least 200 mm.

The outgoing cable to be terminated in the switchboard shall be XLPE insulated PVC sheathed armoured and of size upto 4C x 240 sq. mm Aluminum conductors. The cables shall have bottom entry to the switchboard.

11.7 INTERNAL WIRING

The LT AC distribution boards shall be supplied with complete internal wiring . The control wiring shall be of 1100 V grade , PVC insulated . Stranded tinned (not less than 48 strands) copper conductor cables of 1.5 mm ^{2} size shall be used for control circuits and 2.5 mm^2 for CT circuits. Engraved identification ferrules , marked to correspond with the wiring diagram shall be fitted at both ends of each wire . All wiring shall be terminated on terminal blocks . Terminal blocks shall be one piece moulded and suitable for 500 V and of recommended make. Terminals shall be adequately rated for the short circuit current. Typically terminals of 'Phoenix Contact' make shall be provided which shall be approved by purchaser during detailed engineering.

For CT circuits, shorting type terminals shall be provided. It shall be possible to measure the CT current through clip-on-ammeters. For CT & PT circuits 2.5 sq. mm cable of above standard shall be used.

12 DETAILS OF CIRCUITS

Each switchboard shall have the following circuit arrangement. For details single line drawings be referred.

(i) Incoming

(a) 1 no. 3 phase, 4 wire incomer four pole air circuit breaker electrically operated with short circuit release. The breaker shall conform to IEC 947/IS 13947.

It shall be withdrawal type. The control supply can be provided from a line connected PT from the LT connection from the transformer, any other arrangement given by bidder can also be considered during detailed engineering.

(b) 3 No. – Metering CTs of ratio 800/5, 10 VA class 1

(c) 3 No. – Protection CTs of ratio 800/5, 10 VA, 5 P15.

(d) The incomer breaker shall have three over currents relay of setting 50% to 100% of 1 A rating with IDMTL; current Vs time characteristics.

(e) 1 no. 100x100 mm. flush mounted ammeter of 800 Amps with suppressed scale along with selector switch.

(f). 1 no. bus voltmeter scale 0-500 V (with Isolating PTs) with selector switch suitable for measuring phase to phase and phase to neutral voltages.

(g) 1 no. static three phase meter to measure kWh, kVA, pf and maximum demand on half hourly intervals.

(h) LED type lamps to indicate breaker closed, open, auto trip indications.

(i) DC supply for PSS shall be through in built 24V power pack.

(ii) Outgoing feeders

3 phase 4 wire, outgoing cable circuits shown in different drawings are envisaged from the switchboard and each circuit shall have the following equipments indicating instruments, terminal connectors etc.

(a) 4 pole Moulded Case Circuit Breakers of appropriate rating as indicated in the single line diagrams.

(b) 3 nos. current transformers of secondary rating 5A & 1.0 accuracy class and the primary current of the CTs shall be as per normal current rating of the MCCBs.

(c) 1 no. 100 x 100 mm flush mounted ammeter as per CT rating along with selector switch.

(d) 4 way links for each of the outgoing feeders to isolate the external cables for testing purpose.

(e) Termination points for 4C, XLPE, Al. Armoured cables with lugs.

(f) Gland plate, double compression brass glands chrome plated for 4C, XLPE armoured, Al., Cables.

(g) The LT board must have sufficient space of not less than 100 mm between two cable for termination.

(h) Necessary clamping arrangement for the outgoing feeder cables.

(i) Indicating lights – red, yellow and blue for the supply.

13 EARTHING

(i) The LT switchboard shall be provided with two separate earthing terminals on its casing. The earthing terminals shall be of galvanized bolts, nuts and washers, of size of not less than 12 mm dia. on either side of apron.

All metal parts, enclosure, transformer and neutral have to be interconnected and ready for connection to the external earthing arrangement by bidder.

(ii) The earthing terminals shall be identified by means of proper indelible green sign marks adjacent to the terminals.

(iii) The switchboard shall also have an inside earth bus bar for connecting the cable gland earthings and the armouring to it. The size of the earth bus bar shall be suitable to carry 50 kA for one second. The bus bar shall not be visible or removable from outside the switchboard. The earth bus bar shall have necessary holes, nuts & bolts including washers for making earth connection of cable glands/armouring of the cables.

14 SWITCHBOARD LIGHTING & HEATING

A lamp holder with a 6 W LED lamp and operated by an internal SP-MCB shall be fitted for internal illumination. In addition, a 3-pin 6A/25A socket shall also be provided with a separate SP-MCB. Space heater of suitable rating, with thermostat and SP MCB shall also be provided inside the near the bottom to avoid any moisture condensation inside the switchboard.

15 DANGER NOTICE PLATES

An enameled sheet steel danger plate of approved design as per IS: 2551 shall be fixed on the middle upper front of the switchboard.

16 PAINTING

All sheet steel work shall be phosphatized in accordance with the following procedure and in

accordance with relevant IEC/IS 6005 Code of practice for phosphatizing iron and steel.

All grease, dirt and swraf shall be thoroughly removed by brush cleaning with water and sodium carbonate.

Rust and scale shall be removed by pickling with diluted acid followed by washing with running water, finishing with slightly alkaline hot water and drying.

After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and drying.

The phosphate coating shall be sealed with the application of two coats of ready mixed stoving type zinc chromate primer. The first coat may be flush dried while the second coat shall be stoved.

After application of the primer, two coats of finishing synthetic enamel paint of reputed make shall be applied, each coat followed by stoving. The second finishing coat shall be applied after completion of tests. The colour for the finishing paint shall be light gray as per shade no. 631 of IS: 5 or other equivalent standard shade. Each coat of primer and finishing paint shall be with slightly different shade to enable inspection of the painting.

The finishing painted surface of switchboards shall present aesthetically pleasing appearance free form dents and uneven surface.

The inside surfaces of the switchboard shall be painted white.

A small quantity of finishing paint shall be supplied for minor touching up required at site after the installation of the switch board.

17 TESTS

(i) Type Tests

The purchaser may ask the bidder to conduct the following type tests on one of the AC, LT Boards, considering the altitude factor.

(a) Verification of temperature rise limits test
(b) Verification of rain test to determine the degree of protection against rain
(c) Verification of dielectric properties.
(d) Necessary type tests as per IS on all individual items such as ACBs, MCCB's etc.
(e) Short circuit test.

The purchaser, at his option, may waive the above type tests provided type test reports

of the above type tests carried out on essentially identical unit in their factory/testing laboratory are furnished by the manufacturer.

(ii) **Routine Tests**

(a) The switchboard shall be subjected to power frequency voltage tests described in the relevant ISS. The test voltage to be applied shall be for a period of one minute. Considering the altitude of 1500 m, the test voltage would be above the value recommended for an altitude of 1500m.

(b) Meggar tests with meggar of 500 volts before and after the high voltage test shall be carried out on the switchboard and the recorded readings shall be furnished to the purchaser prior to the dispatch.

(c) Routine tests, as per IS shall be carried out on the bought out items viz. MCCB's and MCBs etc.

(d) Voltage test on auxiliary circuits

(e) Mechanical operation test on control & interlocks

(f) Verification of wiring & earth continuity.

(iii) **Site Tests**

Purchaser at its sole discretion reserves to carry out the necessary tests at site to ensure that the equipment is not disturbed/damaged during transportation.

18. INSPECTION

18.1 All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and the purchaser at the time of purchase. The manufacturer shall afford the inspectors representing the purchaser all reasonable facilities, without any extra charge, to satisfy them that the material is being furnished in accordance with this specification. All the inspection and test reports, certificates shall be submitted by the supplier and got approved from the purchaser before dispatch of equipment.

18.2 As far as factory inspection is concerned, it will happen only at the time of delivery which will be about 11 months from the LOA. At that time if COVID-19 situation goes away we can carry out factory inspection. If situation does not improve we can either do it with tests through virtual link or inspect after decontamination at the Border to ensure the quality of the equipments.

18.3 The inspection by the purchaser or his authorized representatives shall not relieve the bidder of their obligation of furnishing equipment in accordance with the specification, and if at any it is found that equipment has not been tested as desired by Purchaser, the same would be rejected. All the expenses related for inspection shell be borne by the contractor

18.4 The purchaser has right to have the test carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.

19 RECOMMENDED SPARES

The bidder shall provide a list of recommended spares along with cost of each item, in the schedule provided for 5 (five) year operation. The cost of recommended spares shall not be included in bid evaluation. The purchaser shall have the option to select the desired items and it would from a part of separate order.

20 COMPLETENESS OF EQUIPMENT

All fittings and accessories, which may not be specifically mentioned in the specification but which are necessary for the satisfactory operation shall be deemed to be included in the specification and shall be furnished by the contractor without extra charges. The equipment shall be complete in all details, whether such details are mentioned in the specification or not, without any financial liability to the Purchaser under any circumstances.

21 DEVIATIONS FROM SPECIFICATIONS

All the deviations from the specifications shall be separately listed in specified Annexure in the absence of which it will be presumed that the provisions of the specifications have been fully complied with by the bidder.

22 GUARANTEED TECHNICAL PARTICULARS

All Schedules annexed to the specification, shall be duly filled by the bidder separately given in Volume-" Technical Bid Schedules"

15. Earthing Specification

SCOPE

These specifications cover the technical requirements for the design, engineering, manufacture, assembly, and services for supply, insurance, transportation, delivery at Project site, handling, storage and preservation at store / site, transport to place of installation, complete work of site assembly, erection, testing at site & commissioning of earthing system at 33 kV substations sites complete with accessories as specified herein. Any other equipment not explicitly mentioned herein but are necessary for completeness of works specified shall also be included in the scope.

STANDARDS

The equipments / material of the earthing system shall confirm to the following Indian/equivalent international Standards: -

IS : 2026 – 1992 - Steel for general structural purposes

IS: 808- 1991 - Dimensions for hot rolled steel beam, column and angle Sections.

IS : 816 – 1992 - Code of practice for use of metal arc welding for general construction in mild steel.

IS: 1364- 1992 - Hexagon head bolts, Screws and nuts of product grades A & B
IS : 1599 – 1992 - Methods for bend test.

IS : 1608 – 1991 - Method for tensile testing of steel products.

IS : 1521 – 1991 - Method for tensile testing of steel wire.

IS: 2629 – 19990 - Recommended practice for hot dip galvanizing on iron & Steel.

IS : 2633 – 1992 - Method of testing of uniformity of coating of Zinc coated Articles.

IS : 4826 – 1992 - Hot dip galvanized coating on round steel wires.

IS : 6745 – 1990 - Method for determination of mass of Zinc coating On Zinc coated iron and steel articles.
IS : 209 – 1992 - Zinc ingot

16. Description

The bidder shall prepare the design of grounding system, earthing mat/ grid/electrode etc. for the sub- stations in accordance with ANSI/IEE Std. 142, IS : 3043, ANSI / IEEE- 80 and IS : 2026 for 1 second duration of fault current as per protection systems provided safe step touch and transfer potentials, shall be calculated for the earthing mat.
The same shall be got approved before procuring the material. The bidder shall make arrangement to supply grounding material (flat, pipes, round etc.) as per design approved by the purchaser. The grounding of the equipment and devices shall be with G.S flats of required sizes, ground electrodes etc. The earthing terminal of lightning arrestors shall be directly connected to rod earth electrodes which in turn shall be connected to station earthing grid. The earthing lead from the neutral of the power transformer shall be directly connected to two pipe electrodes in treated earth pits as per IS: 3043. Two ground connections shall be arranged for all the equipments and devices, as per IE rules/standards.

The tentative size of the flats for ground mat to be used shall be as follows :

I)	Substation	-	GI flat 50 x 10 mm
II)	Riser	-	50 x 6 mm
III)	Earthing electrodes	-	3 meters long x 40 mm dia MS rod

Earthing Electrode for - 50 mm dia x 3 meter G.I pipe or earth pit treated

earthing pits as per IS: 3043

Earthing arrangement shall be provided for earthing each cable, PVC cable gland, neutral bus bar, chassis and frame work of the cubicle with separate earthing terminals at two ends. The main earthing terminals shall be suitably marked .The earthing terminals shall be of adequate size, protected against corrosion, and readily accessible. These shall be identified by means of sign marked in a legible manner on or adjacent to terminals.

17. Erection

Erection of Packaged Substation

The bidder shall install Packaged Substations for BHU at Integrated New Doksum Township, Doksum, Trashiyangtse as per the description mentioned elsewhere. The work of installation includes all associated Civil works such as excavation, foundation which shall be 400 mm from above the finished floor level, working space of 3 feet PCC all around the PSS, approach path including leveling, grading, drainage, trenching, excavation, back- filling of the packaged sub-stations including earthings complete.

Termination of Control and Power cables

The various sizes of cables terminating on the PSS shall be laid by the purchaser up to the equipment. It shall be the responsibilities of the contractor of this packaged to terminate these cables to his equipment **installed including termination kits.** The supply, installation & fixing of cable glands, however, shall be the responsibility of the contractor. After all cables are installed and all equipment wiring, devices and fixtures have been connected by the bidder, he shall conduct such insulation and operating tests as in his opinion are necessary to demonstrate the adequacy of the electrical installations and to ensure that no damage has occurred to the cables during the installation. All runs, connections, soldering and taping of conductors shall be made neatly and spare for the lugs should be provided.

18. General Equipment

- The equipment earthing should be done to comply with rule 61 (2) of the I.E

  Rules 1956.

- The noncurrent carrying parts of equipment / devices shall be connected to grounding mat by 50 x 6 mm G.S flats.
- The conductor laid below ground level shall be mild steel black flat and that above ground level shall be galvanized mild steel flat.

- The various structures in outdoor yard shall also be grounded as per standards by using 50x6mm size of G.S flats to the main ground mat.

- All joints of grounding flat between themselves & grounding electrodes should be over lap welded. The length of weld shall be at least double the width of grounding flat.

- The earth conductors shall be free from pitting, laminations, rust, scale and other electrical & mechanical defects. The contractor shall install the grounding system in the entire packaged Substation and complete all ground connections as per approved drawing or as directed by the Engineer In charge.

- The connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested & checked shall be painted with anti-corrosive point / compound the connection between equipments earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds shall be treated with red lead compound and afterwards thickly coated with bitumen compound and covered with bitumen impregnate & tape .All welded connections shall be made by electric arc welding.

- Where diameter of bolt for connecting the earth bar to equipment exceeds one quarter of the width of the earthing strip / flats, the connection to the bolt shall be made with a wider piece or flag of material jointed to the earth strip / flat.

- Resistance of the joint shall not be more than the resistance of the equivalent length of conductor.
- A ground mat of fine mesh shall be provided below operating mechanism of isolator.

- For transformer neutral earthing and lightning arrester earthing, treated earth pits shall be provided with 50-mm dia, 3-meter long G.I pipe.

- The contractor shall make the short circuit current calculations for the design of the earth mat. In its absence, the fault level of switchgear shall be considered.

19. Earthing Conductor Layout

Earthing conductors buried in ground shall be laid minimum 600 mm below ground level as otherwise decided during detailed engineering. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filing shall be placed in layer of 150 mm.

Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.

A minimum earth cover of 300 mm shall be provided between earth conductor and the bottom of trench /foundation/ underground pipes at Crossings.

Earthing conductor along their run in cable trenches etc. shall be supported by suitable welding /cleating at interval of 750 mm to 1000 mm.

20. Earthing Pit

Earthing conductor around the enclosure shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the Packaged substation. In case high temperature is encountered at same locations, the earthing conductor shall be laid minimum 1500 mm away from such locations.
Earth pit shall be made and electrodes shall be embedded below permanent moisture level.

21. Technical Particulars

i) Earthing mat : Tentative size of 50 x 10 mm GI Flat / round.

ii) Equipment earthing :Tentatively of 50 x 6 mm G.I. flat complete with clamps and accessories.

iii) Pit Earthing : 50 mm dia. G.I. pipe, 3 meters long of fixing with earth mat.

iv) Soil Resistivity : to be checked, measured and satisfy himself by the contractor after the award of contract to achieve the desired values less than 2 ohms.

22. Tests On Transformer

The Transformers shall be completely factory tested before dispatch in accordance with the standards and with such other tests as may be necessary to ensure that the equipment is satisfactory and is in accordance with this specification.

Routine Tests

Transformer routine tests shall include tests stated in latest issue of IS:2026 (part-I). These tests shall

also include but shall not be limited to the following :

a) **Measurement of winding resistance.**
b) Voltage ratio on each tapping and check of voltage vector relationship.
c) Impedance voltage at all tapings.
b) Magnetic circuit test.(After routine tests, each core shall be tested for 1 minute at 2 kV between all bolts, side plates and structural steel work.

Immediately prior to the dispatch of the transformer, the magnetic circuit shall be pressure tested for 1 minute at 2 kV A.C. between the core and the earth).

c) Load losses.
d) No load losses and no load current.
e) Absorption index i.e. insulation resistance for 15 seconds and 60 seconds (R60/R15) and polarization index i.e. Insulation Resistance for 10 minutes and one minute (R10 mt/R1 mt).
f) Induced over voltage withstand test.
g) Separate source voltage withstand test (applied potential).
h) Tan delta measurement and capacitance of each winding to each (with all other windings earthed) & between all windings connected together to earth.
i) Dissolved gas analysis test.
j) Measurement of acoustic noise level.
k) Measurement of Zero sequence impedance.

Type Tests

Moreover, in addition to the routine tests, the transformer shall be subjected to the following type tests :

a) **Lightning Impulse Test**

This test shall be carried in accordance with clause 12 of the latest issue of IS;2026 (Part-III). The bidder shall quote separate price for lighting impulse test on HV and LV windings. (one limb only).

b) **Temperature Rise Test**

The temperature rise test shall be carried out in accordance with IS:2026 Part-II. The Temperature rise shall not exceed the values stated elsewhere in the specification.

Test Waival, Procedures and Costs

(i) The purchaser, at his option, may waive impulse tests, provided type test reports of impulse tests, carried out on essentially identical units in

their factory in India during the last three years are furnished by the manufacturer and are acceptable to purchaser.

(ii) No load losses and exciting current shall be measured at rated voltage, rated frequency and at 90% and 110% of rated voltage, both before and after the lightning impulse tests.

(iii) The method of test loading shall be described in the test report for determination of both average and hottest spot temperature. Where the winding temperature equipment are specified, data shall also be included for calibration of hottest spot temperature indicator.

(iv) Resistance of each winding of each phase shall be measured at principal and at all the taps and corrected to 75°C.

(v) Impedance voltage shall be measured at principal and at all taps,

(vi) No load Loss Measurement at 415 Volt.

(vii) The bidder shall indicate separately the cost of each of the following type tests :

a) Lightning impulse test separately for HV and LV winding.
b) Temperature rise test.

Test on Associated Equipment

Porcelain bushings, temperature indicating devices, dial thermometers, buchholz relays, OFF LOAD tap changer, coolers, control devices, insulating oil and other associated equipment shall be tested by the contractor in accordance with relevant IS. If such equipment are purchased by the contractor on a sub-contract, he shall have them tested to comply with these requirements.

Sequence of Testing on Assembled Transformer

Unless otherwise agreed, the sequence of testing shall be as follows :

i) Ratio and vector group
ii) Winding resistance measurement
iii) Insulation resistance measurement
iv) Separate source voltage withstand test
v) Measurement of Iron losses
vi) Load losses and Impedance voltage measurement
vii) Lightning Impulse test
viii) Temperature Rise test
ix) Induced voltage withstand test
x) Measurement of Iron loss
xi) Measurement of Insulation resistance

Test Measurements

(i) The Zero Sequence Impedance, insulation power factor and capacitance for each winding and between windings shall be measured and recorded.

(ii) Certified test report and oscillograms shall be furnished to the Purchaser/Consultants for evaluation as per the schedule of distribution of documents. The Contractor shall also evaluate the test results and rectify the defects in the equipment based on his and the Purchaser's evaluations of the tests without any extra charges to the Purchaser. Manufacturer's Test Certificates in respect of all associated auxiliary and ancillary equipment shall be furnished.

(iii) The bidder shall state in his proposal the testing facilities available at his works. In case full testing facilities are not available, the bidder shall state the method proposed to be adopted so as to ascertain the transformer characteristics corresponding to full capacity testings.

Witnessing of Tests and Excessive losses

(i) The Purchaser and/or his representative reserves the right to witness any or all tests.

(ii) The Purchaser reserves the right to reject the Transformer if losses exceed the declared losses beyond tolerance limits as per IS or if temperature rise of oil and winding exceed the values specified elsewhere.

Site Tests

The following site test (as applicable for oil transformer or Vacuum pressure impregnated dry transformer) shall be carried out at site.

a) After the transformer is installed, the following pre-commissioning tests and checks shall be done before putting the transformer in service.

i) Insulation test
ii) Resistance measurement of windings
iii) Ratio test
iv) Phase relationship test
v) Tap changer test
vi) Low oil level alarm
vii) Temperature Indicators & alarms
viii) Magnetizing current

ix) Buchholz relay alarm & trip

b) The following additional checks shall be made to see the following :

i) All oil valves are in correct position closed or opened as required.
ii) All air pockets are cleared.
iii) Thermometer pockets are filled with oil.
iv) Oil is at correct level in the bushing, conservator, tank etc.
v) Earthing connections are made.
vi) Colour of Silica gel is blue.
vii) Bushing arcing horn is set correctly and gap distance is recorded.

23. Inspection on Package Substation

All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and the purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities, without any extra charge, to satisfy him that the material is being furnished in accordance with this specification. All the inspection and test reports, certificates shall be submitted by the supplier and got approved from the purchaser before dispatch of equipment.

The inspection by the purchaser or his authorized representatives shall not relieve the bidder of their obligation of furnishing equipment in accordance with the specification, and if at any it is found that equipment has not been tested as desired by Purchaser, the same would be rejected. All expenses for inspection shall be borne by the contractor.
The purchaser has right to have the test carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.

The bidder shall provide training to three officials for the three days at manufacturing site as well as at site at the expense of the contractor. However, if COVID -19 situation persist, we can exercise our discretion to deduct the amount for Training of Ngultrum three lakhs inclusive of airfare, DSA, Training fee and other expenses.

24. Tests

All equipment and components shall be subjected to routine tests according to relevant standards and such other tests including type, acceptance & site/commissioning tests as may be required to ensure that all equipment and components are satisfactory and in accordance with the specification. Any modification required in the testing procedure shall be made as directed by the purchaser at no additional cost to the purchaser. No equipment shall be dispatched

from the manufacturer's works before the relevant tests reports have been approved by the purchaser.

It shall be certified by the supplier that the type tests in accordance with the relevant standards have been successfully carried out on all devices being supplied by him, Certified copies of all type tests shall be submitted with the tender. The test reports shall provide sufficient data to substantiate that the equipment offered meets the requirement of the standards.

25. Completeness of Equipment

All fittings and accessories, which may not be specifically mentioned in the specification but which are necessary for the satisfactory operation shall be deemed to be included in the specification and shall be furnished by the contractor without extra charges. The equipment shall be complete in all details, whether such details **are mentioned in the specification or not, without any financial liability to the Purchaser under any circumstances.**

26. Deviation from Specifications

All the deviations from the specifications shall be separately listed in specified Annexure in the absence of which it will be presumed that the provisions of the specifications have been fully complied with by the bidder.

27. Acceptable Makes of the Equipment

1.	Enclosure of Compact Sub-station	-Areva/Siemens/ABB /ALSTOM/Schneider
2.	HT Switchgear	Areva/Siemens/ABB /ALSTOM/Schneider
3.	LT Switchgear	C&S/L&T/ABB/GE/SIEMENS
4.	Transformer	Areva/ABB/Nucon/ Kotsons/Danish/CGL/ALSTOM
5.	HT Panel Relays	As per manufacturer's practice
6.	HT Cable	HAVELs/RR /RPG/ FINOLEX/ POLYCAB
7.	HT Cable and termination	3M/RPG/Denson/Cable Accessories/Venus Cables

HT & LT Power Cables

Supply

Cables of the following sizes required for the HT and LT package shall be in the scope of the bidder.

a). 3C X 185 sq.mm 33 kV (E) XLPE Aluminium.Power cable steel armoured

b). 4core x 240 Sq.mm 1.1 kV XLPE Al. Power Cable steel armoured cable.

c). 4core x 150 Sq.mm 1.1 kV XLPE Al. Power Cable steel armoured cable.

d). 4core x 16 Sq.mm 1.1 kV XLPE Al. Power Cable steel armoured cable.

e). 2core x 10 Sq.mm 1.1 kV XLPE Al. Power Cable steel armoured cable.

f). 2core x 6 Sq.mm 1.1 kV XLPE Al. Power Cable steel armoured cable.

Installation

(i) Cables shall not be bent sharp to a small radius either while handling or in installation. The minimum safe bending radius for XLPE (MV) cables shall be 12 times the overall diameter of the cable. At joints and terminations, the bending radius of individual cores of a multi core cable of any type shall not be less than 15 times its overall diameter.

(ii) The ends of lead sheathed cables shall be sealed with solder immediately after cutting the cables. In case of PVC cables, suitable sealing compound/tape shall be used for this purpose, if likely exposed to rain in transit storage. Suitable heat shrinkable caps may also be used for the purpose.

Route

(i) While the shortest practicable route should be preferred, the cable route shall generally follow fixed developments such as roads, foot paths etc. with proper offsets so that future maintenance, identification etc. are rendered easy. Cross country run merely to shorten the route length shall not be adopted.

(ii) Cable route shall be planned away from drains and nears the property,

especially in the case of HV/LV cables, subject to any special local requirements that may have to be necessary complied with.

(iii) Corrosive soils, ground surrounding sewage effluent etc. shall be avoided for the routes.

(a) Whenever cables are laid along well demarcated or established roads, the HV/LV cables shall be laid further from the kerb line than HV cables.

(b) Where cables cross one another, the cable of higher voltage shall be laid at a lower level than the cable of low voltage.

Proximity to communication cables

Power and communication cables shall as far as possible cross each other at right angles. The horizontal and vertical clearances between them shall not be less than 60 cm.

2. Laying Direct in Ground

The method shall be adopted where the cable route is through open ground, along roads/lanes, etc. and where no frequent excavations are likely to be encountered and where re-excavation is easily possible without affecting other services.

Trenching

Width of trench.

The minimum width of the trench for laying a single cable shall be 45 cm.

i. Where more than one cable is to be laid in the same trench in horizontal formation, the width of the trench shall be increased such that the inter-axial spacing between the cables, except where other specified, shall be at least 20 cm.

ii. There shall be a clearance of at least 15 cm between axis of the end cables and the sides of the trench.

Depth of Trench

i. Where the cables are laid in a single tier formation, the total depth of trench shall not be less than 75 cm for cables upto 1.1 kV and 1.2 m for cables above 33 kV.

ii. When more than one tier of cables is unavoidable and vertical formation of laying is adopted, the depth of the trench in (i) above shall be increased by 30 cm for each additional tier to be formed.

iii. Where no sand cushioning and protective covering are possible to be provided for the cables, the depth of the trench as per (i) and (ii) above shall be

increased by 25 cm.

Laying of Cable In Trench

(i) (a) The trench shall then be provided with a layer of clean, dry sand cushion of not less than 8 cm in depth, before laying the cables therein.

(b) However, sand cushioning as per (a) above need not be provided for MV cables, where there is no possibility of any mechanical damage to the cables due to heavy or shock loading on the soil above.

(c) The supply of the materials required for protecting the cable such as sand, bricks, HDPE/RCC Hume pipes etc. shall be in the scope of contractor.

(d) Where ever the cable route comes across the wall/cable likely to be exposed HDPE pipe of required sizes has to be used with proper clamping at the required interval.

(ii) Testing before laying

At the time of cable laying, the cables shall be tested for continuity and insulation resistance.

(iii) The cables shall be tested for continuity of cores and insulation resistance and the cable length shall be measured, before closing the trench, the cable end shall be sealed/covered.

(iv) Sand covering

Cables laid in trenches in single tier formation shall have a covering of dry sand of not less than 17 cm above the base cushion of sand before the protective cover is laid.

In the case of vertical multi-tier formation, after the first cable has been laid, a sand cushion of 30 cm shall be provided over the base cushion before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cm as stated above. Cables in the top most tier shall have a final sand covering not less than 17 cm before the protective cover is laid.

(v) Extra loop cables

(a) At the time of original installation, approximately 3 m of surplus cable shall be left on each terminal end of the cable and on each side of the underground joints. The surplus cable shall be left in the form of a loop, where there are long rungs of cables such loose cable may be left in the form of a loop. Where there are long runs of cables such loose cable may be left at suitable intervals as

specified by the Engineer-in-charge.

(b) Where it may not be practically possible to provide separation between cables when forming loops of a number of cables as in the case of cables emanating from a substation, measurement shall be made only to the extent of actual volume of excavation, sand filling etc. and paid for accordingly.

(vi) Mechanical protection over the covering

(a) Mechanical protection to cables shall be laid over the covering in accordance with (b) and (c) below to provide warning to future excavations of the presence of the cable and also to protect the cable against accidental mechanical damage by pick-axe blow etc.

(b) Unless otherwise specified, the cables shall be protected by second class brick of nominal size 22cm x 11.4cmx7cm or locally available size, placed on top of the sand (or, soil as the case may be), the bricks shall be placed breadth-wise for the full length of the cable. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at least 5 cm over the sides of the end cables.

(c) Where bricks are not easily available, or are comparatively costly, there is no objection to use locally available material such as titles.

Back Filling

(i) The trenches shall be then back-filled with excavated earth, free from stones or other sharp edged debris and shall be rammed and watered, if necessary in successive layers not exceeding 30 cm depth.

(ii) Unless otherwise specified, a crown of earth not less than 50 mm and not exceeding 100 mm in the center and tapering towards the sides of the trench shall be left to allow for subsidence. The crown of the earth however, should not exceed 10 cm so as not to be a hazard to vehicular traffic.

(iii) The temporary re-statements of roadways should be inspected at regular intervals, particularly during wet weather and settlements should be made good by further filling as may be required.

(iv) After the subsidence has ceased, trenches cut through roadways or other paved areas shall be restored to the same density and materials as the surrounding area and re-paved in-accordance with the relevant building specifications to the satisfaction of the Engineer-in-charge.

(v) Where road beams or lawns have been cut out of necessary, or kerb stones dispatched, the same shall be repaired and made good, except for turfing/asphalting to the satisfaction of the Engineer-in-charge, and all the surplus earth or rock shall be removed to places as specified.

ROUTE MARKERS

(i) Location

Route markers shall be provided along the runs of cables at locations approved by the Engineer-in-Charge and generally at intervals not exceeding 10 m. Markers shall also be provided to identify change in the direction of the cable route and at locations of underground joints.

(ii) Plate type marker

Route markers of 100 mm x 100 mm x 5mm GI/Aluminium plate with the inscription shall be provided by the purchaser. Such plate markers shall be mounted parallel to and at about 0.5m away from the edge of the trench. However the contractor is required to mount the same on MS nuts & bolts of required size the PCC block of 150mm x 150mm at the top and 300mm x 300mm at the bottom with the height of 400mm.

Laying in Pipes/Closed Ducts

(i) HDPE pipe, Stone ware pipes, GI, CI or spun reinforced concrete pipes shall be used for cables in general, however only GI pipe shall be used as protection pipe on poles.

(ii) The size of pipe shall not be less than 10 cm in diameter for a single cable and not less than 15 cm for more than one cable.

(iii) Where steel pipes are employed for protection of single core cable feeding AC load, the pipe should be large enough to contain both cables in the case of single phase system and all cables in the case of poly phase system.

(iv) Pipes for HV/LV cables shall be independent ones.

Road Crossings:

(i) The top surface or pipes shall be at a minimum depth of 1 m from the pavement level when laid under roads, pavements etc.

(ii) The pipes shall be laid preferable askew to reduce the angle of bend as the cable enters and leaves the crossing. This is particularly important for HV cables.

(iii) When pipes are laid cutting an existing road, care shall be taken so that the soil filled up after laying the pipes is rammed well in layer with watering as required to ensure proper compaction. A crown of earth not exceeding 10 cm should be left at the top. The existing road that has been cut shall be immediately repaired maintaining the quality of road undisturbed at no extra cost.

Cable Identification Tags

Whenever more than one cable is laid/run side by side, marker tags as approved, inscribed with cable identification details shall be permanently attached to all the cables in the manholes/pull pits/ joint pits/ entry points in building/open ducts etc. These shall also be attached to cables laid direct in ground at specified intervals, before the trenches are backfilled.

3. Jointing

i. Before laying a cable, proper locations for the proposed cable joints, if any, shall be decided, so that when the cable is actually laid, the joints are made in the most suitable places. As far as possible, water logged locations, carriage ways, pavements, proximity to telephone cables, gas or water mains, inaccessible place, ducts pipes, racks etc. shall be avoided for locating the cable joints.

ii. Joints shall be staggered by 2 m to 3 m when joints are to be done for two or more cables laid together in the same trench.

B. LOW VOLTAGE FEEDER CUM STREET LIGHT PILLARS

1. Scope

This specification covers the design, engineering manufacture, testing at works, packing, supply, delivery, erection, testing and commissioning of low voltage outdoor type feeder and street lighting pillars including all mounting bolts and other accessories required to make the pillars commercially operable for 3 phase, 4 wire, 415 volts, 50 Hz. neutral grounded distribution system. The pillars shall be complete with links, MCCBs, MCBs, Bus bars, Voltmeter/Indicating lights & all such other accessories as required, even though specifically not mentioned.

2. Standards and System Conditions

2.1 STANDARD

The equipment covered in this specification shall conform to the following updated I.E.C. Publications/ISS.

IS: 375: Marking and arrangement for switchgear bus-bars, main connectors and auxiliary wiring.

IS: 589: Basic climatic & Mechanical durability test for components for electronic & electrical equipment.

IS: 1336: Push buttons

IS: 1554: PVC Insulated (Heavy duty) electric cables.

IS: 2147: Degree of protection provided by enclosure

IS: 3202: Climatic proofing of electrical equipment

IS: 4064: Air break switches, air break disconnectors, air break switch disconnectors and fuse combination units for voltages not exceeding 1000 V.

IS: 5039-1991 Distribution pillars for voltage not exceeding 1000 Volts.
IS: 8623 : (Part I-3) Specification for switchgear & control assemblies.
IS: 8828: Specification for MCBs

IS: 13947 (Part- II) Low voltage switchgear and control gear.

IEC 664 A-1980: Insulation co-ordination with in low voltage systems including clearance and Creepage distance for equipment.

IS: 2551: Danger plate

IS: 10580: Service conditions for electrical equipment

IS: 39-1987: Guide for insulation co-ordination within low voltage systems. IS:6005: Code of practice for phosphating Iron & Steel.

The equipment complying with other internationally accepted standards shall also be considered if they ensure performance equivalent to or superior to Indian Standards.

3. **Systems Details**

The distribution system being provided is an underground system. The electrical sub-transmission system is fed through 33 kV BPC lines. The system on 33 kV side is solidly grounded. One 33 kV feeders have been tap-off from 33 kV BPC feeder which is approx. 150 mtrs away from the colony to feed a number of distribution transformers situated at various locations. Th distribution transformer being fed from 33 kV system is of 500 KVA, 33/0.415 kV, having 4 % impedance, delta star vector group, with neutral solidly grounded, which feeds a

415 V, LT board. Each LT board feeds a number of feeders/service pillars of 3 phase, 4 wire, 415 V rating. From these pillars 4 core/2 core underground cables shall be laid to a number of houses or for the street lighting as indicated in the single line diagram.

4. Climatic and ISOCERUNIC Condition

i)	peak ambient temp. of air	50°C
ii)	Minimum ambient temperature of air	- 5° C
iii)	Maximum relative humidity	90%
iv)	Average no. of thunder storm	40
v)	No. of average rainy days per annum	127
vi)	Number of months of Tropical	4 months
vii)	Snow storm	Nil
viii)	Average annual rainfall	107 mm
ix)	Altitude for design purposes	1500 m
x)	Seismic zone	V
xi)	Basic horizontal seismic coefficient	0.08
xii)	Maximum wind pressure-	195 kg/m²

5. Quality of Material

All material used shall be new and of best quality and of class, most suitable for working under the conditions specified herein without distortion or deterioration.

6. Design and Standardization

GENERAL

i) The equipment shall be designed to ensure satisfactory operation in which continuity of service is the first consideration and shall also be designed to withstand sudden load variations due to short circuits and fault conditions. The design shall incorporate every reasonable precautions and shall have necessary provision for the safety of all those concerned in the operation and maintenance of the pillars.

ii) The mechanism shall be made of such materials as to prevent sluggishness due to rust or corrosion. All connections and contacts shall be of ample section and contact surface for carrying continuously the specified current without undue heating and shall be secured rigidly and locked in position. Standard sizes of bolts, screws, pipes and other fittings are to be used and number of sizes is to be kept to the minimum.

iii) Cast Iron shall not be used for any part of the equipment, which may be subjected to mechanical stresses.

iv) All apparatus shall be so designed and constructed as to obviate the risk of short circuits of the live parts by lizards etc. Metal cubical, housings and covers shall be 100% weather/vermin proof & shall be able to provide the degree of protection IP 65 in accordance with latest version of IS-2147.

v) All parts shall be manufactured in accordance with relevant standard specifications of .IEC/IS. Corresponding parts of similar equipment, and apparatus shall be mutually interchangeable.

vi) All apparatus, connection and cabling shall be designed and arranged to minimize the risk of fire and any damage which might be caused in the event of fire.

vii) The distribution feeder/service pillars shall be suitable for working outdoors in the conditions given herein. As the feeder/service pillar will be installed normally on footpaths adjoining to the roads, these shall be made robust and capable of withstanding the vibrations normally experienced due to vehicular traffic.

CLEARANCE & CREEPAGE DISTANCES

The clearance & creepage distance shall be in accordance with IS 13947 Part – I updated & corrected for operation at an altitude of 1500 m as per IEC; 664/SP:39-1987 of B.I.S.

7. Labels and Marking of Connections/Feeder Pillars

All apparatus, control gear and the apparatus mounted there on shall be clearly labeled indicating, their purpose and the 'ON' 'OFF' and 'EARTH' positions, as applicable. The labels shall be clearly lettered on enameled surface or other approved materials. Brass should not be used for labels. Each phase of alternating current and connections shall be coloured by heat shrinkable sleeves to distinguish phase, neutral and earth. The colouring shall be red, yellow, blue, for phases black for neutral and green for earth. The labeling shall be finalized after the samples and arrangement for the same is to be get approved by the successful bidder during

detailed engineering.

8. Drawing & literatures

Four sets of tentative G.A, schematic drawings and detailed literature of equipment shall be submitted with the tender clearly giving the scope of supply and bill of material of enable the purchaser to scrutinize all aspects of design including arrangement and support of cable accessibility for maintenance work and future additions, cable connections, general appearance etc.

Further four sets of drawings & literature as given in respective schedule are to be furnished by successful tenderer/bidder within 2 weeks after the award of contract by the purchaser, which shall include the following:

i) Complete assembly drawings of the pillars, showing plan, elevation, typical section, location of terminal blocks for external wiring connections and mounting details of various devices with dimension.

ii) Foundation plan showing embedment channel frame in the floor with associated holes and suitable size of bolts for fixing to channel frame of feeder pillars.

iii) Wiring diagrams including terminal wiring design and cable schedule.

iv) Schematic control diagram for controls, relays, instruments, space heaters, cubicle illumination and receptacle etc

v) Detailed bill of material of each feeder pillar.

9. Bought out items

All bought out items such as switches, MCCBs, MCB's, meters, terminals, cables etc. shall be of reputed make. Purchaser reserves the right **to accept only materials of proven make at its sole discretion.**

10. Construction Details

i) A totally enclosed cubicle shall be fabricated out of heavy gauge CRCA steel sheets of thickness not less than 3.00 mm on all sides and mounted on angle iron frame. A set of double hinged doors shall be provided on front & back to enable installation, maintenance and inspection of cable connection and other equipment inside the cubicle from the front/back side. Three heavy duty inside

hinges (not visible from outside) shall be provided per door in such a way so that interior gasketing of the doors shall be continuous. Good quality neoprene gaskets, weather resistant shall be used. The design shall permit the doors being completely removed when necessary. The doors shall be so fitted as to provide the interior with maximum protection from atmospheric conditions. The doors shall get closed as in case of a steel almirah through a handle so as to have a tight fitted door. The door shall be provided with a locking arrangement inside the panel as assessable to operate from outside, just below the handle operable through a single master key.

ii) Arrangement to provide pad lock shall also be provided in addition to the above arrangement.

The voltmeter, selector switches, MCB's shall be provided on the incoming side of the MCCB on an openable and separate leaf inside the pillar and not on the main door leaves.

iii) The top of the pillar shall have a sloping canopy and shall project over the sides of the pillar shell which shall be lower than the top section.

iv) The pillar is to be mounted on brick and cement concrete plinth by the road side and the dimensions should be such that it does not obstruct the normal traffic on the foot path. All civil works including materials shall be in the scope of the bidder.

v) The lower part i.e. apron should be covered with 3.00 mm CRCA sheet on all sides. The sheet covers shall be welded to the frame on all sides except where doors are fixed where it should be bolted so that it can be removed for fixing cables. Ingress of water or any other insects etc does not take place from this portion as well.

vi) The stand shall be made of angle iron 75 x 35 x 6 mm and shall have adequate height to provide a strong supporting structure to the shell.

vii) Suitable ventilation louveres with wire mesh inside shall be provided at the bottom and top on the side sections of the shell in an M. S flat frame welded inside so that no object, lizard etc can enter the pillar through the ventilation louvers.

viii) The gland plate shall be of thickness 3.15 mm & detachable type. All the cable glands shall be chrome plated and double compression type and shall be supplied with the pillar box for the cable sizes given.

ix) The busbars shall be rectangular and of electrolytic aluminum.

Phase as well as neutral shall be suitable for 400 Amps continuous current rating or more as required. The bus bars shall be insulated with heat shrinkable tapes with red, yellow and blue colours for the 3 phases and black for neutral. All bus bar tapping and markings shall be in accordance with relevant IEC/IS, 375-1963. The bus bars shall be mounted on unbreakable insulators. The interconnection between bus bars and MCBs units shall be solid electrolytic Aluminum/strip/Aluminum conductor permanently riveted with the busbar. The connections between outgoing side of MCBs and outgoing cable shall be through an isolating link so as to ensure a physical isolation of outgoing circuit whenever needed. These shall be suitably taped with colours as that of bus bars. Thimbles, nuts & bolts etc., (which must be non rusting) for the incoming and outgoing cables terminals shall be included & provided with the pillar. Only external cables shall be brought from outside by the purchaser for making connections to the pillars at site. The bus bar joints shall be given a thin coat of conducting grease after fully cleaning both the surfaces. The terminals shall be of substantial mechanical strength & shall provide adequate electrical contact for the cable size used & shall be capable of receiving the size of cable. It will be ensured that necessary contact pressure is maintained permanently.

The above arrangement shall be got approved by bidder prior to fabrication.

11. Details of Circuits

Each feeder pillar shall have the following circuits:

i) Incoming

One incoming supply from the 415 V busbar of the substation shall be fed to the feeder pillar through a 4 pole MCCB of 315 A or higher (320 A>)with (50 to 100% setting) 50 KA rated, as indicated in the single line diagram.

ii) Outgoing Feeders

1/3 three phase 2/4 wire outgoing circuits fed by MCCB's/ MCB's of ratings 32/63/100A/125/250/320 Amps. (as indicated in the single line diagram). The feeder pillar shall be provided with above rating described feeding the outgoing circuits of equivalent capacity through 4 C, 25/50 sq. mm and 2 core 25 sq. mm cables from the feeder pillar. A four pole disconnecting link of the rating corresponding to the rating of MCCB shall also be provided between the cable connection terminals and MCB. This link shall provide visible disconnection in the case of any maintenance work required to be carried out on the outgoing cable circuit.

12. Earthing

i) The distribution feeder pillar shall be provided with two separate earthing terminals on its casing. The earthing terminals shall be of galvanized bolts, nuts and washers, of size 12 mm x 25 mm on either side of apron.

ii) The earthing terminals shall be easily accessible and so placed that the earthing

connections of the distribution pillars are maintained when the cover or any other moveable part is replaced.

iii) The earthing terminals shall be identified by means of proper indelible green sign marks adjacent to the terminals.

iv) The feeder pillar shall also have an inside earth bus bar for connecting the cable gland earthings and the armouring to it. The size of the earth bus bar shall be suitable to carry 50 kA for one second. The bus bar shall not be visible or removable from outside the cubical. The earth bus bar shall have necessary holes, nuts & bolts including washers for making earth connection of cable glands/armouring of the incoming/outgoing cables.

13. Feeder Pillar lighting and Heating

A lamp holder with a 6 W LED lamp and operated by an internal SP-MCB shall be fitted in the canopy of the feeder pillar for internal illumination. In addition, a 3 pin 5 A, Universal Socket shall also be provided with a separate SP-MCB on side of the pillar box, Space heater of suitable rating, with thermostat and SP MCB shall also be provided inside the pillar near the bottom to avoid any moisture condensation inside the cubicle.

14. Danger Plate

An enameled sheet steel danger plate of approved design as per IS: 2551 shall be fixed on the left upper front door of the pillar written in both English and Dzongkha.

15. Painting

All sheet steel work shall be phosphatized in accordance with the following procedure and in accordance with relevant IEC/IS 6005 code of practice for phosphatizing iron and steel.

All grease, dirt and swarf shall be thoroughly removed by brush cleaning with water and sodium carbonate.
Rust and scale shall be removed by pickling with diluted acid followed by washing with running water, finishing with slightly alkaline hot water and drying.

After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and drying.

The phosphate coating shall be sealed with the application of two coats of ready mixed stoving type zinc chromate primer. The first coat may be flush dried while the second coat shall be stoved.

After application of the primer, two coats of finishing EPOXY paint of reputed make shall be applied, each coat followed by stoving. The second finishing coat shall be applied after completion of tests. The colour for the finishing paint shall be light grey as per shade no. 631 of IS : 5 or other equivalent standard shade. Each coat of primer and finishing paint shall be with slightly different shade to enable inspection of the painting.

The finishing painted surface of pillars shall present aesthetically pleasing appearance free form dents and uneven surface.

A small quantity of finishing paint (200 ml) shall be supplied with each pillar for minor touching up required at site after the installation of the pillars.

16. Tests

i) Type Tests

The purchaser may ask the manufacture to conduct the following type tests on one of the feeder pillars out of any of the consignment, considering altitude factor.

a) Verification of temperature rise limits test.

b) Verification of rain test to determine the degree of protection against rain

c) Verification of dielectric properties.

d) Necessary type tests as per IS on all the bought out items such as MCB's, MCCB's etc.

The purchaser, at his option, may waive the above type tests provided type test reports of the above type tests carried out on essentially identical unit in their factory/testing laboratory in India are furnished by the manufacturer.

ii) Routine Tests

a) The pillars shall be subjected to high voltage tests described in the relevant ISS. The test voltage to be applied shall be for a period of one minute. Considering the altitude of 1500 m, the test voltage would be above the value recommended for an altitude of 1500 m.

b) Megger tests with megger of 500 volts before and after the high voltage test shall be carried out on the feeder pillars and the recorded readings shall be furnished to the purchaser prior to the dispatch of feeder pillar.

c) Routine tests, as per IS shall be carried out on the bought out items viz. MCCB's and MCBs etc.

iii) Site Tests

Purchaser at its sole discretion reserves to carry out the necessary tests at site to ensure that the equipment is not disturbed/damaged during transportation.

17. Inspection

All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and the purchaser at the time of purchase. The manufacturer shall afford the inspectors representing the purchaser all reasonable facilities, without any extra charge, to satisfy them that the material is being furnished in accordance with this specification. All the inspection and test reports, certificates shall be submitted by the supplier and got approved from the purchaser before dispatch of equipment.

The inspection by the purchaser or his authorized representatives shall not relieve the bidder of their obligation of furnishing equipment in accordance with the specification, and if at any it is found that equipment has not been tested as desired by Purchaser, the same would be rejected. All expenses for inspection shall be borne by the contractor .

The purchaser has right to have the test carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.

As far as factory inspection is concerned, it will happen only at the time of delivery which will be about 11 months from the LOA. At that time if COVID-19 situation goes away we can carry out factory inspection. If situation does not improve we can either do it with tests through virtual link or inspect it after decontamination at the Border to ensure the quality.

18. Cable Terminations

Incoming and outgoing cables to be terminated in the feeder pillar shall be Al, PVC, 1.1 kV grade PVC insulated PVC sheathed armoured and of following sizes.

Incoming Al, PVC, 4Cx240,4cx150,

Outgoing 2cx6 ,2cx 10, 2 C x 16, 4 C x 25, 4 C x 50, sq.mm Aluminum PVC insulated armoured conductor cable.

Horizontal angle iron bars shall be provided with bolted holes so that the cables could be clamped by 'U' bolts of 12 mm diameter, so that no pull is exerted on the terminals due to the weight of the cable. U bolts of necessary size to clamp the cables shall be supplied fitted with nuts & washers, fitted on the angle iron bars.

19. Street Lighting Pillars

The L. T. street lighting service pillars shall be manufactured suitable for outdoor installation and shall have all constructional details, earthing arrangement, danger plate, painting, other features and tests as specified under various paras above for L.T. feeder/service pillars. The final paint on the street lighting service pillars shall be red. The L. T., street lighting pillars shall have circuits as detailed below:

i) **Incoming**

One no. 3 phase, 4 wire incoming circuit placed on the left hand side having 4 pole MCCB of rating 200 Amps complying with IS: 13947-2 as updated with 50 – 100% adjustable thermal release and & breaking capacity of 36 kA suitable for incoming PVC aluminum conductor cable of size 4C x 240 sq. mm and Provision to install Energy Meters and Controller to be included.

ii) **Outgoing circuits**

7 nos. single phase 2 wire outgoing circuits with voltage rating of 230 volts & current rating of 25 A having 2 pole, MCB of 32 A rating, suitable for outgoing armoured aluminum cable of 2 x 25 sq. mm size.

iii) **Time switch**

1 no. electrically operated Astronomical time switch complete with 2 NO 2 NC contactor arrangement. A 63 amp 4 pole MCB shall protect the incoming circuit. A 3-pole contactor having 63 amps. Capacity 2 NO, 2 NC auxiliary contacts will be fixed in between the incoming MCB and the bus bar. This time switch will control the contactor. The time switch shall have 6 to 10 years backup battery life.

20. MOULDED CASE CIRCUIT BREAKERS (MCCB's)

i) The incoming underground cable to the feeder pillar from the LT AC Board in the substation shall be controlled by moulded case circuit breaker.

ii) The moulded case circuit breakers shall be of a robust construction and shall comprise of a switching mechanism, contact system, arc extinguishing device and a tripping unit contained in a compact moulded case and cover. The insulating case and cover shall be made of high strength, heat-resistant and flame-retardant thermo-setting insulating material.

The switching mechanism shall be quick-make/quick break type, and should be trip free.

The arc extinguishing device shall comprise of a series of grid plates mounted in the parallel between supports of insulating material. The arc shall be drawn from the moving contact into the divide chamber and extinguished.

The moulded case circuit breakers shall have a thermo-magnetic type tripping mechanism, where the heating effect and the electromagnetic effect of current are made use of to provide protection against overload and short circuit conditions respectively. The heated-bimetal strip in each phase of the MCCB shall actuate the tripping system following on inverse-time-current characteristics depending upon the severity of the overload. During short- circuits, the system shall trip instantaneously. The tripping element provided on each pole of the MCCB shall operate on a common trip bar, thereby preventing single phasing in the event of fault occurring on any of the phases. The tripping device shall be ambient temperature compensated type.

The MCCB shall have a minimum rupturing capacity of 25.8 MVA. Positive indication about the position of the MCCB i.e. whether 'ON' 'OFF' or TRIPPED shall be provided.

The short circuit breaking capacity and operating of the MCCB shall be supported by test certificates.

iii) The detailed specifications of the MCCBs shall be as under:

1.	3 phase 4 wire, neutral earthed system no. of pole : 4 pole	
2.	Service voltage	415 volts
3.	Normal current	Rating shown in SLD
4.	Frequency	50 Hz.
5.	Breaking capacity	25.8 MVA
6.	Short time current rating	36 KA for one sec.
7.	Making current	75.6 KA

iv) Crimp type cable lugs shall be used on the outgoing side of the MCCBs and the 4 pole links for each of the outgoing feeder.

All the MCCBs, used in LT feeder/service/street lightning pillars for controlling the LT feeders shall have a current setting of 50 to 100% of its rated current.

21. MOULDED CASE CIRCUIT BREAKER (MCCB)

i) The outgoing underground feeders/service lines from the LT feeder pillars shall be controlled by MCCBs. It shall provide protection against over loads and short circuit.

The MCCBs shall be of robust construction with insulating case made of self extinguishing, thermoplastic material. The switching mechanism shall be quick make/quick break and shall be trip free. The details specification of the MCBs shall be as under:

1.	No. of poles	4 and 2 poles as required

2.	Service voltage	415/240 volts
3.	Normal current	Rating shown in SLD
4.	Frequency	50 Hz.
5.	Breaking capacity	20 kA

22. Specific Technical Parameters

L.T. A. C. FEEDER PILLAR

Feeder Pillar

i)	Rated voltage	3 phase,4 wire 400 volts ± 5%
ii)	Rated current at 40°C (A)	as per rating shown in single line diagram
iii)	Frequency (Hz)	50
iv)	Symmetrical short circuit withstand Current for 1 sec at rated voltage (kA rms)	36
v)	Degree of protection as per IS: 2147 for Outdoor IP 65	
vi)	Material of Cubical	
	- Cubical sheet metal for panel	CRCA
	- Thickness, structural frames and load Bearing members for panel (mm)	3.00
	- Thickness, front & rear (mm)	3.00
	- Thickness sides & top (mm)	3.00
	- Size of Angle Iron Support frame	75 mm x 35 mm x 6 mm
vii)	Painting shade as per IS:5	
	- External surfaces	631 (Epoxy)
	- Internal surfaces	white

viii) Minimum clearance air (bus-bars)

- Between phase	As per relevant IS for operation at an altitude of 1500 m
- Between phase & earth	- do –

ix) Bus-bar Details

- L. T. Feeder pillar	Electrolite Aluminum used for busbar & construction shall be preferably equivalent to E91 E of B.S. 2398 with mechanical strength properties approximating closely to that of copper.
-	Protection against accidental contact conductive dust etc. Heat shrinkable sleeving withr equisite dielectric properties leaving no voids or pin holes. Sleeving to be permanent & non removable by hand. Bus bars joints and tee off, where possible to be provided with removable shrouds for complete isolation.

x) Temperature rise over design — As per relevant ISS

ambient temperature of 40°C for continuous current rating deg.

xi) Indicating lamps — 230 V

xii) Space Heater rated voltage — 230 V

COMPONENTS

i) MCCB

- No. of pole	4 pole
- Rating (A)	As shown in single line diagram
- Short time current rating (kA)	36

	- Thermal Tripping range	50 to 100%
	- Short circuit release	suitable up to 36 kA
ii)	MCB	
	- No of pole	4 pole
	- Rating (A)	As per SLD
	- Rupturing capacity (kA)	20
	- Tripping	Thermal overload
iii)	RCCB	
	- No of pole	2 pole
	- Rating (A)	20
	- Leakage current (mA)	30
	- Rupturing capacity (kA)	20
	- Tripping	Thermal overload & current leakage

23. Recommended Spares

The bidder shall provide a list of recommended spares along with cost of each item, in the schedule provided for 5 (five) year operation. The cost of recommended spares shall not be included in bid evaluation. The purchaser shall have the option to select the desired items and it would from a part of separate order.

24. Completeness of Equipment

All fittings and accessories, which may not be specifically mentioned in the specification but which are necessary for the satisfactory operation shall be deemed to be included in the specification and shall be furnished by the contractor without extra charges. The equipment shall be complete in all details, whether such details are mentioned in the specification or not, without any financial liability to the Purchaser under any circumstances.

25. Deviation from Specifications

All the deviations from the specifications shall be separately listed in specified Annexure in the absence of which it will be presumed that the provisions of the specifications have been fully complied with by the bidder.

E. Erection Works

1. Scope of The Work

This covers tentative requirements for erection/installation, testing and commissioning of LV Feeder Pillars, Street light poles/fixtures, LV Power cables & all associated civil works under Power Distribution System (PDS) & Street lighting for BHU of New Doksum Integrated Township, Trashiyangtse, Bhutan. All the materials required for completion of this work is in the scope of the bidder whether specifically mentioned in the Bill of Quantities and specification or not but required to complete the work as per latest standard SQCA/IS/IEC specification.

The electrical and associated equipment shall be erected in conformity with the SQCA/IS/IEC latest specifications with amendments up to date for electrical works while complying in all respects with the requirements of the latest relevant rules in force at the time of execution and in conformity with the requirement of Indian Standard, codes/International codes and practices, Indian & Bhutan safety rules and all other statutory regulations of RGoB that may be relevant to erection and testing & commissioning as per requirements of IS/IEC.

The contractor shall furnish all labour, skilled and un-skilled, supervisory and administrative personnel, skilled and certified Cable jointer, all erection tool & tackles, testing and commissioning equipment, implements necessary for timely and effective execution of the contract. The installation work is exclusive of supply of erection material, hardware and consumable items to complete the installation under turnkey execution of the project.

2. Feeder Pillar

Erection of Feeder Pillar, Street Light poles and fixtures.

Feeder Pillar, Street light poles with junction box accessories and street light fixtures, PVC insulated 2.5 sq. mm Copper conductor required for connecting the street light fixture from the junction box including cable lugs as required for connection shall be provided by the purchaser. The erection of Feeder pillars, Street light poles and fixtures includes foundation, base frame support, earthing & PCC below and all around the feeder pillars & street light poles including excavation, leveling, grading, drainage, trenching, excavation, back-filling etc to complete the works in all respect.

Termination of Control and Power cables

The various sizes of cables terminating on the Feeder Pillars shall be laid by the contractor up to the equipment. It shall be the responsibilities of the contractor of this package to terminate these cables to the equipment installed with appropriate Brass cable gland and lugs. The cable

termination shall be supplied by the contractor to suit various sizes of cables. The supply, installation & fixing of cable glands shall be the responsibility of the contractor. After all cables are installed and all equipment wiring, devices and fixtures have been connected by the bidder, he shall conduct such insulation and operating tests as in his opinion are necessary to demonstrate the adequacy of the electrical installations and to ensure that no damage has occurred to the cables during the installation. All runs, connections, soldering and taping of conductors shall be made neatly.

Testing and Commissioning

Before the Feeder Pillar, Street light Poles and fixtures and cables are energized, necessary commissioning tests may be conducted and any adjustments etc. required to be made in the equipment may be carried out. After all the pre-commissioning tests are successfully carried out, the panel/pillars/fixtures shall be put into commercial operation and handed over to the purchaser. The commissioning test reports shall be submitted to the purchaser for his approval.

Feeder Pillar Checks

Contractor shall carry out the following checks on all Feeder pillars under the project, and submit the report to Purchaser

1) The installation has been carried out in accordance with the approved drawings.
2) Phase-to-phase and phase-to-earth clearances are provided as required.
3) All equipments are efficiently earthed and properly connected to the required number of earth electrodes.
4) The required ground clearance to live terminals is provided.
5) All cable trenches are provided with non-flammable covers.
6) Free accessibility is provided for all equipments for normal operation.
7) All name plates are fixed and the equipment are fully painted.
8) All construction materials and temporary connections are removed.
9) Bus bar tightness etc. are in order.
10) For earth connections, brass bolts and nuts with lead washers are provided in the pipes/-plates.
11) Earth pipe troughs, pits are free from rubbish and dirt and stone jelly and the earth connections are visible and easily accessible.
12) Panels and switchgears are all vermin and damp proof and all unused openings or holes are blocked properly.
13) The earth bus bars are checked for tightness and for corrosion free joint surface.
14) Safety devices, horizontal and vertical barriers, bus bar covers/shrouds, automatic safety shutters/doors interlock, handle interlock for safe and reliable operation in all panels and cubicles.

15) Clearances in the front, rear and sides of the switchboards are adequate.
16) All incoming and outgoing circuits of panels are clearly and indelibly labeled for identifications both at the front and at the rear.

3. Erection of Poles

Scope and Technical Requirements

Under normal conditions the cement concrete footing (isolated) shall be of reinforced cement concrete of M15 grade for each pole. If called for, after ascertaining the soil properties, the pole foundations may be of special type e.g. R.C.C., Raft, etc. subject to approval by the Owner or his authorized representative.

Standards

The materials/services covered in this specification shall be supplied as per requirement of the relevant standards/codes given below.

List of Indian Standards

Sl.No.	Indian Standard (IS)	Title
1	IS : 432 – 1982	Mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement
2	IS : 1786 – 1966	Cold twisted steel bars for concrete Reinforcement
3	IS : 383 – 1990	Coarse and fine aggregates from natural sources of concrete
4	IS : 456 – 2000	Code of practice for plain and reinforced concrete
5	IS : 1893 – 1975	Criteria for earthquake resistant design of structures
6	IS : 1883 – 1971	Method of load test on soils
7	IS : 4091 – 1979	Code of practice for design and construction of foundation for transmission line towers and poles
8	IS : 3025 – 1964	Water to be used for construction
9	IS : 2502-1963	Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement

Excavation of Pits

a) The planting depth of pole over the base concrete should be maintained 1/6th of

the pole height.

b) Excavation cost for pits shall be included by the contractor in the bid for following type of soils inclusive of dewatering of pits and shoring and shuttering wherever necessary.

i) All type of soils and soil conditions but excluding hard rock
ii) Hard rock

No separate claim for dewatering during excavation, shoring and shuttering shall be entertained. For hard rock, the excavation cost per location shall remain same for all type of foundations. **No blasting for the pit shall be permitted.**

Foundation & Pole Erection

The foundation of poles shall be of the Concrete Foundation.

The bidder shall quote their rates as per the quantity of foundations indicated in the BPS. The pole erection rate shall include excavation in all types of soil/rock, back-filling of the foundation pole as specified, cost of all the other materials & labour except the street light pole with junction box accessories and street light fixtures shall be provided by the purchaser.

a) **Concrete Foundation**

The PCC Foundation should be of size 75 cm X 75 cm X Depth, where depth is equal to the 1/6th of the respective pole height. The PCC shall be of 1:2:4 (M15 grade). Excavation size of the pit shall be commensurate with the foundation size of PCC stated above.

The pole is to be erected in alignment and also 90 Degree straight with utmost care and the excavated earth should be back filled with excavated earth or brick bats or PCC as applicable.

b) **Erection of Poles:**

The poles are to be erected in alignment with utmost care. The poles shall then be lifted to the pit with the help of wooden supports. The pole shall then be kept in the vertical position with the help of 25 mm (min.) manila ropes which shall act as the temporary anchor. The verticality of the pole shall be checked by sprit level in both longitudinal & transverse directions. Once, this is done, the back filling/concreting shall be done in the pit. The temporary anchor shall be removed only when poles set properly in the foundation.

Back filling of Pits

a) All the locations, (with following exceptions), the pits after erection of poles with PCC as mentioned in Sl No. 3.4(a) above the remaining space shall be back filled with excavated or borrowed earth in layers taking care to ram the earth in one layer

at a time to the satisfaction of site-in-charge.

b) The cost of backfilling including all material/borrowed earth/Broken Brick etc is deemed to be included in the quoted price.

The above clauses shall be read in conjunction with clause no. 5.0 given below.

Earthing of Poles

All the street lighting poles shall be earthed with Rod type earthing as per latest Construction Standards.

4. LT Power Cables

Supply

Cables of the following sizes required for the package shall be in the scope of the bidder.

a) 4core x 240 Sq.mm 1.1 kV XLPE Al. Power Cable steel armoured.

b) 4 core x 150 Sq.mm 1.1 kV XLPE Al. Power Cable steel armoured.

c) 4 core 50 Sq.mm 1.1 kV XLPE Al. Power Cable steel armoured.

d) 2 core x 25 Sq.mm 1.1 kV XLPE Al. Power Cable steel armoured.

e) 2 core x 16 Sq.mm 1.1 kV XLPE Al. Power Cable steel armoured.

f) 2 core x 10 Sq.mm 1.1 kV XLPE Al. Power Cable steel armoured.

g) 2 core x 6 Sq.mm 1.1 kV XLPE Al. Power Cable steel armoured.

Installation

(iii) Cables shall not be bent sharp to a small radius either while handling or in installation. The minimum safe bending radius for XLPE (MV) cables shall be 12 times the overall diameter of the cable. At joints and terminations, the bending radius of individual cores of a multi core cable of any type shall not be less than 15 times its overall diameter.

(iv) The ends of lead sheathed cables shall be sealed with solder immediately after cutting the cables. In case of PVC cables, suitable sealing compound/tape shall be used for this purpose, if likely exposed to rain in transit storage. Suitable

heat shrinkable caps may also be used for the purpose.

Route

(iv) While the shortest practicable route and existing footpath provisioned for cable duct should be preferred, the cable route shall generally follow fixed developments such as roads, foot paths etc. with proper offsets so that future maintenance, identification etc. are rendered easy. Cross country run merely to shorten the route length shall not be adopted.

(v) Cable route shall be planned away from drains and nears the property, especially in the case of HV/LV cables, subject to any special local requirements that may have to be necessary complied with.

(vi) Corrosive soils, ground surrounding sewage effluent etc. shall be avoided for the routes.

(a) Whenever cables are laid along well demarcated or established roads, the HV/LV cables shall be laid further from the kerb line than HV cables.

(b) Where cables cross one another, the cable of higher voltage shall be laid at a lower level than the cable of low voltage.

Proximity to communication cables

Power and communication cables shall be as far as possible cross each other at right angles. The horizontal and vertical clearances between them shall not be less than 60 cm.

5. Laying Direct in Ground

The method shall be adopted where the cable route is through open ground, along roads/lanes, etc. and where no frequent excavations are likely to be encountered and where re-excavation is easily possible without affecting other services.

Trenching

Width of trench

The minimum width of the trench for laying a single cable shall be 45 cm.

i. Where more than one cable is to be laid in the same trench in horizontal formation, the width of the trench shall be increased such that the inter-axial spacing between the cables, except where other specified, shall be at least 20 cm.

ii. There shall be a clearance of at least 15 cm between axis of the end cables and the sides of the trench.

Depth of Trench

i. Where the cables are laid in a single tier formation, the total depth of trench shall not be less than 75 cm for cables upto 1.1 kV and 1.5 m for cables above 11 kV.

ii. When more than one tier of cables is unavoidable and vertical formation of laying is adopted, the depth of the trench in (i) above shall be increased by 30 cm for each additional tier to be formed.

iii. Where no sand cushioning and protective covering are possible to be provided for the cables, the depth of the trench as per (i) and (ii) above shall be increased by 25 cm.

Laying of Cable In Trench

(i) (a) The trench shall then be provided with a layer of clean, dry sand cushion of not less than 8 cm in depth, before laying the cables therein.

(e) However, sand cushioning as per (a) above need not be provided for MV cables, where there is no possibility of any mechanical damage to the cables due to heavy or shock loading on the soil above.

(f) The supply of the materials required for protecting the cable such as sand, bricks, HDPE/RCC Hume pipes etc. shall be in the scope of contractor.

(g) Where ever the cable route comes across the wall/cable likely to be exposed HDPE pipe of required sizes has to be used with proper clamping at the required interval.

(ii) Testing before laying

At the time of cable laying, the cables shall be tested for continuity and insulation resistance.

(iii) The cables shall be tested for continuity of cores and insulation resistance and the cable length shall be measured, before closing the trench, the cable end shall be sealed/covered.

(iv) Sand covering

Cables laid in trenches in single tier formation shall have a covering of dry sand of not less than 17 cm above the base cushion of sand before the protective cover is laid.

In the case of vertical multi-tier formation, after the first cable has been laid, a sand cushion of 30 cm shall be provided over the base cushion before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cm as stated

above. Cables in the top most tier shall have a final sand covering not less than 17 cm before the protective cover is laid.

(v) Extra loop cables

(c) At the time of original installation, approximately 3 m of surplus cable shall be left on each terminal end of the cable and on each side of the underground joints. The surplus cable shall be left in the form of a loop, where there are long rungs of cables such loose cable may be left in the form of a loop. Where there are long runs of cables such loose cable may be left at suitable intervals as specified by the Engineer-in-charge.

(d) Where it may not be practically possible to provide separation between cables when forming loops of a number of cables as in the case of cables emanating from a substation, measurement shall be made only to the extent of actual volume of excavation, sand filling etc. and paid for accordingly.

(vi) Mechanical protection over the covering

(a) Mechanical protection to cables shall be laid over the covering in accordance with (b) and (c) below to provide warning to future excavations of the presence of the cable and also to protect the cable against accidental mechanical damage by pick-axe blow etc.

(b) Unless otherwise specified, the cables shall be protected by second class brick of nominal size 22cm x 11.4cmx7cm or locally available size, placed on top of the sand (or, soil as the case may be), the bricks shall be placed breadth-wise for the full length of the cable. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at least 5 cm over the sides of the end cables.

(c) Where bricks are not easily available, or are comparatively costly, there is no objection to use locally available material such as titles.

Back Filling

(i) The trenches shall be then back-filled with excavated earth, free from stones or other sharp edged debris and shall be rammed and watered, if necessary in successive layers not exceeding 30 cm depth.

(ii) Unless otherwise specified, a crown of earth not less than 50 mm and not exceeding 100 mm in the center and tapering towards the sides of the trench shall be left to allow for subsidence. The crown of the earth however, should

not exceed 10 cm so as not to be a hazard to vehicular traffic.

(iii) The temporary re-statements of roadways should be inspected at regular intervals, particularly during wet weather and settlements should be made good by further filling as may be required.

(iv) After the subsidence has ceased, trenches cut through roadways or other paved areas shall be restored to the same density and materials as the surrounding area and re-paved in-accordance with the relevant building specifications to the satisfaction of the Engineer-in-charge.

(v) Where road beams or lawns have been cut out of necessary, or kerb stones dispatched, the same shall be repaired and made good, except for turfing/asphalting to the satisfaction of the Engineer-in-charge, and all the surplus earth or rock shall be removed to places as specified.

ROUTE MARKERS

(i) Location

Route markers shall be provided along the runs of cables at locations approved by the Engineer-in-Charge and generally at intervals not exceeding 10 m. Markers shall also be provided to identify change in the direction of the cable route and at locations of underground joints.

(ii) Plate type marker

Route markers of 100 mm x 100 mm x 5mm GI/Aluminum plate with the inscription shall be provided by the contractor. Such plate markers shall be mounted parallel to and at about 0.5m away from the edge of the trench. However the contractor is required to mount the same on MS nuts & bolts of required size the PCC block of 150mm x 150mm at the top and 300mm x 300mm at the bottom with the height of 400mm.

Laying in Pipes/Closed Ducts

(i) HDPE pipe, Stone ware pipes, GI, CI or spun reinforced concrete pipes shall be used for cables in general, however only GI pipe shall be used as protection pipe on poles.

(ii) The size of pipe shall not be less than 10 cm in diameter for a single cable and not less than 15 cm for more than one cable.

(iii) Where steel pipes are employed for protection of single core cable feeding AC load, the pipe should be large enough to contain both cables in the case of single phase system and all cables in the case of poly phase system.

(iv) Pipes for HV/LV cables shall be independent ones.

Road Crossings:

(i) The top surface or pipes shall be at a minimum depth of 1 m from the pavement level when laid under roads, pavements etc.

(ii) The pipes shall be laid preferable askew to reduce the angle of bend as the cable enters and leaves the crossing. This is particularly important for HV cables.

(iii) When pipes are laid cutting an existing road, care shall be taken so that the soil filled up after laying the pipes is rammed well in layer with watering as required to ensure proper compaction. A crown of earth not exceeding 10 cm should be left at the top. The existing road that has been cut shall be immediately repaired maintaining the quality of road undisturbed at no extra cost.

Cable Identification Tags

Whenever more than one cable is laid/run side by side, marker tags as approved, inscribed with cable identification details shall be permanently attached to all the cables in the manholes/pull pits/ joint pits/ entry points in building/open ducts etc. These shall also be attached to cables laid direct in ground at specified intervals, before the trenches are backfilled.

6. **Jointing**

iii. Before laying a cable, proper locations for the proposed cable joints, if any, shall be decided, so that when the cable is actually laid, the joints are made in the most suitable places. As far as possible, water logged locations, carriage ways, pavements, proximity to telephone cables, gas or water mains, inaccessible place, ducts pipes, racks etc. shall be avoided for locating the cable joints.

iv. Joints shall be staggered by 2 m to 3 m when joints are to be done for two or more cables laid together in the same trench.

STREET LIGHTING POLES, FIXTURES AND ACCESSORIES

1. Scope

This specification covers the Supply,delivery, erection, testing and commissioning of street lighting and compound lighting system for BHU at New Doksum Integrated township, Trashiyangtse, Bhutan.
The scope of work shall also include but not limited to:

i) Lighting fixtures with lamps and accessories
ii) Junction boxes/switch boxes
iii) Street light poles
iv) Cables, wires, splicing/termination/connection accessories
v) Conduits with accessories, junction and pull boxes, terminal blocks, etc.
vi) Earth wire and connections
vii) All fittings, supports, brackets, anchor bolts, clamps etc.
viii) Any other item/equipment/material for completion of the above works. Minor civil works like fixing of anchor bolts, breaking floors for fixing conduits/pipes/earth conductors, sealing of floor openings after layout of conduits, pipes and earth conductor shall be carried out by the contractor. Minor civil works associated with erection of switchboards, junction boxes shall also be carried out by the contractor. Complete hardware required for fixing arrangement shall also be included in scope of supply. Civil works for street lighting poles, foundations, outdoor panels and outdoor trenches.

2. **Codes and Standards**

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable IS/IEC Standards except where modified and /or supplemented by this specification. Some of the IS/IEC/BS Standards applicable to the specifications are given as under:

Indian Standard Title

IS : 5 Colour Code

IS: 418 Electric Lamps, tungsten filament general service.

IS: 694 Specification for PVC cables for voltage upto 1100 Volt

IS: 1554 PVC insulated (heavy duty) electric cables for voltage upto 1100 Volts

IS: 1777 Industrial lighting fittings with metal reflectors IS: 1947 Floods lights
IS: 2149 Luminaries for street lighting
IS:2509 Rigid non-metallic conduit for electric installations.
IS: 2667 Fittings for rigid steel conducts
IS: 2713 Tubular Lighting Poles
IS: 3043 Code of Practice for earthing
IS: 3871 MCB
IS:158-1981 Specification for Ready Mixed Paint,
Brushing, Bituminous, Black, Lead-free, Acid, Alkali, and Heat Resisting for General Purposes.
IS: 209-1992 Specification for Zinc Ingots
IS: 228-1987 (Part III)
IS: 228-1989 (Part IX) Methods of Chemical Analysis of Steel Part-III. Determination of Phosphorous by Alkali metric method.
Methods of Chemical Analysis of Steel Part-IX. Determination of Sulphur in Plain Carbon Steels by Evolution method.
IS: 808 Dimension for Hot rolled steel sections. IS: 1161-1979 Steel tubes for Structural Purposes.
IS: 1367 (Part I)- 1980 Technical supply conditions for Threaded Steel FastenersIS: 1387-1993 General Requirementsfor the Supply of Metallurgical Materials.
IS: 1852-1985 Rolling and Cutting Tolerances for Hot Rolled Steel Sections Products
IS: 1894-1972 Methods for Tensile Testing of Steel Tubes.

IS: 2016 Plain Washers
IS: 2074-1992 Specification for Ready Mixed Paint, Red Oxide- Zinc Chrome, Priming.
IS: 2551-1982 Danger Notice Plates

IS: 2633-1986 Methods of Testing Uniformity on zinc Coated Articles.
IS: 3063-1994 Fastner-Single Coil Rectangular Section spring washers screws.

IS: 4826-1979 Hot dipped galvanized coatings on round steel wires.
IS: 4711-1974 Methods for Sampling of Steel Pipes, Tubes and Fittings.
IS: 5369-1975 General Requirementsfor Plain and Lock WashersIS: 6610-1972 Heavy washers for steel structures
IS:6639-1972 Hexagonal Bolts for Steel Structures
IS: 6745-1972 Method for Determination of Mass of Zinc Coat on Zinc Coated Steel Articles.

Equipment and material conforming to any other standard that ensures equal or better quality including Specification for Electrical Works 2021, MOHS may be accepted.

3. General Technical Requirements

The system provides lighting and electric power supply for lighting system to all areas of colony gates and adjoining areas, bridge top, approach roads, shopping complex, school, hospitals, office complex etc.
The philosophy of illumination design shall be based on achievement of desired illumination levels with minimum glare. In addition to above, the selection of luminaires for various areas should be such that the proposed illumination design is most energy efficient and presentable as per the latest practices.
The design shall be such as to provide average lighting levels for all areas.

The illumination should be uniform and free from shadows or dark patches. The acceptable limits for overall uniformity ratio shall be as per relevant IS and would be specified in the bid.
The service voltages shall be as per the following.:

- Normal lighting system: three-phase, four wire 415/240 V, 50 Hz.

The illumination requirements as specified below are to be provided at different places and other adjoining areas:

Item	Location	Illumination-Level (Lux)
1	Corners/Junction of roads	40
2	Gates and adjoining areas	50
3	School, hospitals, shopping complex	50
4	Approach Roads	50

The bidder is required to design and submit the complete lighting system including the number of fittings required and layouts shall be subject to the approval of the purchaser.

4. Specific Technical Requirement

EQUIPMENT AND MATERIAL

I. Equipment and material shall comply with description, rating, type and size as detailed in the specification.
II. Equipment and materials furnished shall be complete and operative in all details.
III. All accessories, control devices, internal wiring, conduits, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and control/operation of the equipment shall be the part of Supplier's supply.
IV. All parts shall be made accurately to standard gauges to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

LIGHTING FIXTURES

I. Lighting fixtures shall be designed for minimum glare. The surface finish shall be smooth, unobtrusive and scratch resistant.
II. Reflector shall be of sheet steel aluminum, minimum 20 SWG thick, securely fixed by fastening device of captive type.
III. Fixture shall be suitable for 19 mm conduit entry and 16 SWG G.I earthwire connections.
IV. Medium/high bay fixtures shall have provision for vibration damper to ensure rated lamp life.
V. Fixture shall be fully wired up to respective terminal blocks, suitable for connections to PVC wires.
VI. 1x70W, LED, 240V AC Street light luminaire, Epoxy powder coated dia-cast aluminum housing(ADC12), in grey finished with elegantly designed with M16 gland, PC modular lens plate of beam angle 60 degree (LM 79) ,high quality toughened glass IK 07 fixed to housing, Powered by 2 nos. integral, isolated electronic LED driver with lower THD, output Open/Short Circuit protection, Over Voltage protection, Surge Voltage Protection with SPD (10kV) & other safety test IS 15885 part-2/sec-13,suitable for pole mounting. Protection class IP-65/66 (for Lamp Compartment) and IP-65/66 (for Gear Compartment) on single/ double/ triple bracket including wiring from the pole junction box, connection using suitable lugs

LAMP & LAMP HOLDERS

I. All the lamps shall be of general service lighting. LED lamps and fixtures shall be suitable for operation on 240 volts AC and shall have the dimensional & operating characteristics as per relevant IS.
II. All 240 V lamp holders shall have porcelain body or brass body with porcelain

inserts. Lamp holders shall be suitable for Edison screw cap lamps. Edison Screw lamp holders shall have a solid spring loaded centre pin and anti- vibration springs.

III. LED lamp shall be colour corrected type with screwed cap.

IV. Lamps shall be suitable for use in position and capable of withstanding vibrations. Restrictions and special features, if any, shall be clearly indicated in the bid.

V. Supplier shall indicate in his bid the lumens output, average life of lamp, curve for lumens depreciation with time for offered lamps.

Luminaires

General description of LED Streetlight –1x70W, SLIM LED Flood Light/ 240V AC Street light luminaire, Epoxy powder coated dia-cast aluminum housing(ADC12), in grey finished with elegantly designed with M16 gland, PC modular lens plate of beam angle 60 degree (LM 79) ,high quality toughened glass, IK 07, fixed to housing, Powered by 2 nos. integral, isolated electronic LED driver with lower THD, output Open/Short Circuit protection, Over Voltage protection, Surge Voltage Protection with SPD (10kV) & other safety test IS 15885 part-2/sec-13,suitable for pole mounting. Protection class IP-65/66 (for Lamp Compartment) and IP-65/66 (for Gear Compartment) on single/ double/ triple bracket including wiring from the pole junction box, connection using suitable lugs

Fixture, including the LEDs, drivers and electrical components, shall carry a limited ten-year warranty and housing paint and finish shall carry a ten-year warranty.

Optical configurations shall meet the following criteria:

1. No reflectors or single lensed fixture accepted. Close contact refractors to be employed for optical distribution.
2. Refractors are to be polymeric material rated 5VA, f1 rating
3. Lumen maintenance at 50,000 hours of life to be no less than 88% of initial lumen output
4. Shall have 95% survival rate at 50,000 hours.
5. Integral 10K surge suppressor for diode and entire system protection.

SPECIFICATION FOR LED TYPE LUMINARIES FOR STREETLIGHTING AND COMPOUND LIGHTINGS

General:

This specification covers for the LED fitted luminaries used for outdoor and indoor applications for working at 220+/-10%, 50Hz+/-3%, single phase input system. It consist of:

a) Fixture

b) LED

c) Driver and Electronics

Indoor Applications:

The product should be latest state of art and complaint to relevant IEC 60598-1, 2, 3, IEC 62031 and IEC 62612 or their latest edition depending on the type of luminaries. In addition to the above luminaries

shall adhere to relevant BIS standards IS 15885, 16101, 16102, 16103, 16104, 16105, 16106, 16107 (Part I & II) as per the application. The product shall be of proven design should possess type test certificate/ performance certificate from the accredited laboratory. The product and its major components shall be state of art and of proven design.

It should be capable to work at Maximum ambient air temperature of 50°c (For outdoor product) .Housing, if not used as a heat sink shall be made of 0.5 mm thick CRCA Sheet/Extruded aluminium (2mm) or pressure die cast (PDC-2mm) confirming to relevant standards, polyester powder coated of atleast 40 microns and high U.V. and corrosion resistance.

Luminaries should be covered with suitable Glass or diffuser with high transitivity. Outdoor luminaries shall be with clear toughened glass or clear poly carbonate cover.

Lighting fixtures and accessories shall be designed for continuous trouble free operation under diverse atmospheric conditions without deterioration of materials. Degree of protection of enclosure shall be at least IP-65 or IP 66 wherever possible for outdoor fixtures. To be provided with suitable control optics as per need of application and render glare free touser.

Test papers for various parameters i.e. flux, power, efficacy, chromaticity, temperature, protection etc. issued by certified agency shall be furnished. Estimation on product's life and performance shall be furnished.

(a) Fixture:

The fixture should conform to applicable IS 10322/IEC 60598 (all parts and amendments) and should have the associated LM-79 report (for electrical and photo metric test methodology for LED lighting) from accredited lab. Test report shall be submitted along with relevant catalogues. The fixtures should have a surge protection of 2 kV.

LED (Light Emitting Diode)

Manufacturer should have IEC (Illuminating Engineering Society) – LM -80 test report and with projected life as per IEC-LM 21. Test report shall be submitted along with relevant catalogues. All LED to be solid state embedded a sight sources, arrays and modules.

High lumi efficacy LEDs suitable for the application along with following features shall be used:

(i) LED efficacy at the chip levels have 120 lumen/watt (for high power LED)

(ii) The efficiency of the LED at 85 ° c junction temperature shall be more than 85%.

(iii) The system luminous efficacy of LED luminaire shall be as under:

a) Efficacy›60 lumen/watt for low wattage luminaries (‹45W) and

b) Efficacy›80 lumen/watt for high wattage luminaries (›45W).

(iv) Adequate heat sink with proper thermal management shall be provided.

(v) Minimum view angle of the LED shall not be less than 20.

(vi) Power factor of complete fitting shall be more than 0.9.

(vii) LED shall be surface mounted type duly soldered to PCB by reflow system of COB type. The solder used shall be ROHS compatible for environment friendliness.

(viii) Colour rendering index CRI›=70 as specified in the item description.

(ix) Correlated colour temperature shall be in the range of 3000 k-6500 as specified in item description.

LED driver

LED driver shall be capable to withstand and work with input voltage range from 160V (RMS) to 270 V(RMS) with built in 2 kV surge protection. Output voltage of the driver shall be designed to meet the power requirement of the system. Output voltage ripple should be within 3%. Output over voltage

protection should be upto 125V D.C. full load efficiency shall be more than 85%. Total harmonic distortion-For 0-50W shall be less than 25% and above 50 W rating shall be less than 15%.Current wave form should meet EN 61000-3-2. LED driver shall be able to withstand voltage of 350V for 2 hours and restore normal working when normal voltage is applied. The driver should comply to CIS PR 15 formats and methods of measurement of radio disturbance characteristics and it should comply to IEC 61547 for EMC immunity requirement. The control gear should be complaint to IEC 61347-2-13, IEC 62031 and IEC62384.

General

The lumen maintenance of the LED lightings shall not be less than 70% after 50,000 hours i.e. L70 (B50). Free warranty shall commence after delivery and end at 60 months after delivery. The warranty of replaced item shall restart from date of attending defect/replaced.

All exposed hardware shall be stainless steel. All protected hardware not visible after installation shall be cast aluminum and / or stainless steel, hot-dipped galvanized. Anti-seize shall be used.

I. Brackets & Supports

Brackets & supports, if provided, shall be hot dip galvanized after fabrication. The Galvanized brackets shall either be bolted or welded to the structure. All suspensions for LED lamps with integral chokes shall be suspended on 19mm/25 mm conduit. Any steel work damaged by drilling and welding shall be repainted to the original steel work painting specification in the true matching colour.

II. Miniature Circuit Breakers (MCB's)

All the 220 V circuit breakers mounted in the pole shall be of miniature type suitable for manual operation. The miniature circuit breaker shall be of trip free type and shall be provided with thermal over load and instantaneous over current tripping devices to suit full load current for individual circuits.

III. Conduits

The Contractor shall supply and install heavy-duty black enameled mild steel conduits, boxes, wire ways and fixings required to complete the job. All necessary hardware such as screws, bolts, hangers, clamps, locknuts, bushings, conduit pipe, tee drains and box drains, couplings, pulling irons, identification tags, etc. shall be used in the supply.

5. Street Light Poles

i) The Galvanized street light swaged poles with designation as 410SP-41 shall be seamless type, MS pipe as per IS 2713 (Part-II)-1980. Poles shall be complete with base plate & taper plugs, and necessary pipe reducer/fixing

brackets for fixing the lighting fixture and weather proof junction box etc. As depicted in the enclosed drawing.

ii) Lighting poles shall be galvanized as per SQCA/ IS /IEC standard

6. Specific Technical Particulars

DIMENSION OF GALVANIZED POLES & BRACKETS

For the street lighting system, the overall length of the pole shall be 8.50 m as per the arrangement shown in enclosed figure 1.

The other important dimensions of the Galvanized poles shall be conforming to ISS 2713 and are as given below.

1.0	Name of material	8.50 mtr. Long assembly type galvanized steel tubular poles	
	Technical specification	IS 2713 (part-I to III) 1986	
	Application type	Unless otherwise specified	
	Type	Assembly type swaged poles	
	Overall length	8.5 mtrs.	
	Planting length	1.5 mtrs.	
	Load applied from top at the distance	0.6 mtrs.	
	Height above the ground	7.0 mtrs.	
	Length of Sections	a)Top (h1) 2.40 m	
		b)Middle (h2) 2.40 m	
		c)Bottom (h3) 3.20 m	
	Outside diameter and thickness of sections	a) Top (h1) 76.1 x3.25	
		b)Middle (h2) 88.90 x3.25	
		c)Bottom (h3)114.30x3.	
	Approximate weight of the pole based on the assumption that steel weighs 7.85 g/cm3		
	Tolerance unless otherwise specified	As per I.S.I specifications	
	Breaking load	as per IS	
	Crippling load	as per IS	
	Working load at Factor of safety on crippling load and	as per IS	

	breaking load	(158 kgf) respectively
2.15	Load for permanent set not exceeding 13 mm	As per IS/IEC
2.16	Load of temporary deflection of 157.5 mm	As per IS/IEC
2.17	Ultimate tensile strength (kgf/mm2)	As per IS/IEC
2.18	Basic Plate (steel)	250x250x5.4 mm
2.19	Galvanized Bracket size and length	750 mm

GENREAL REQUIREMENTS

The top and middle sections are to be swaged and joined together. The upper edge of the joint should be chamfered off at an angle of about 45° or circumferential weld shall be deposited at the upper edge of the joint at a slope of 45°. The poles should be telescopic. At joint J1 double swagging of bottom section to be done and middle section to be fitted outside and bolted with 6 nos. Of suitable G.I. Nuts & bolts. Flat washer & spring washer etc. The bolts, nuts and washers should be galvanized G.K.W. make. The hole on the bottom and middle section are to be machine drilled. Both sections of each pole should be numbered by metallic engraving for easy recognition and the top section is to be inserted inside the bottom section and transported as one unit. All other specification will be strictly as per IS 2713 (Part – III) 1980.

QUALITY OF MATERIAL

All material used shall be new and of best quality and of class, most suitable for working under the conditions specified herein without distortion or deterioration.

DESIGN AND STANDARDISATION

The poles shall be designed to ensure satisfactory operation of the power system, in which continuity of service is the first consideration and shall also be designed to stand sudden load variations due to short circuits and fault conditions. The design shall incorporate all reasonable precautions and shall have necessary provision for the safety of all those concerned in the operation and maintenance of the power system.

DRAWINGS

The bidder is to submit drawings and instruction manuals along with the tender as required.

However after the award of contract the detailed drawings along with necessary manuals are to be submitted (with any other particulars, the contractor may deem necessary) within 15 days for approval of purchaser. The poles shall be manufactured only after the drawings submitted by bidder have been approved by purchaser in the manner indicated therein, to incorporate the modifications suggested. The distribution shall be as in Schedule no. 9. The copies of finally in-built approved drawings shall be furnished within 15 days of the delivery of the poles.

WORKING CONDITIONS

The steel tubular poles covered by these specifications shall be created for the underground street lighting system to be operated on single phase 230 volts, 50 Hz supply along roads/lanes for in hilly area and high altitude specified. These shall, therefore, be able to withstand the weather conditions of the area and also the vibrations caused by the vehicular traffic.

PROTECTION AGAINST CORROSION

The poles (including base plate) shall be galvanized with conforming to relevant ISS or other standard specifications internally and externally upto 500 mm above the level which goes inside the earth. The remaining portion of the exterior of the poles shall be galvanized as per relevant ISS or other standard specifications including over hand bracket prior to applying weather proof metallic anticorrosive paint conforming to IS 158/1983 or any other finish so asked by the purchaser. No part where a hole or cut has been made be left exposed. The final finish shall be get approved from the purchaser. Sufficient quantity of weather proof paint shall be supplied for application at site.

THE POLES MUST BE PROTECTED AGAINST ATMOSPHERIC CORROSION

The poles are to be created in an hostile atmosphere viz. Low temperature and high humidity. All exposed steel parts have a tendency to rust very quickly for which preventive measures must be provided. As indicated elsewhere all nuts, bolts, washers etc. must be galvanized properly.

MATERIAL OF POLES

The steel used for the manufacturer of poles shall be in conformity with the general requirements relating to the supply of material, as laid down in ISS 1387 or other relevant standards.
The materials, when analyzed in co-accordance with ISS 228 shall not show sulph8r and phosphorous contents of more than 0.06 percent each.

The minimum tensile strength and the minimum percentage elongation of the material shall be as laid down in ISS 2713 and IS: 1894 or other relevant standard specifications.

7. **Constructional Details**

TUBULAR POLES

The Galvanized tubular steel poles shall be of swaged type, made of seamless or welded tubes of suitable lengths swaged together when hot. Seamless swaged Galvanized street light poles

conforming to IS 2713 with current revisions with hot dipped galvanised internally & externally as per IS 2629 with base plate of (250x250x5.4) mm having entry hole of 40mm dia at 1.1m from bottom and struded bolt as earth terminal complete as required (8.5 m) with a junction box mounted inside the pole with locking arrangements including pole cap with single arm of 1.1m long having inner & outer pole tightened with bolt including spike earthing (2500 MM long with 5M long8SWG GI wire each).If welded tubes are used, they shall have one longitudinal weld seem only in the longitudinal welds shall be staggered at each swaged joint. The upper edge of each joint shall be chamfered off at an angle of about 45°. The swaging may be done by any mechanical process. Each swaged portion of the pole shall be jointed with six diametrically placed bolts of appropriate length & diameters, which shall be got approved from the purchaser before manufacturing of poles.

Poles shall be well finish, clean and free from harmful surface defects. Ends of the poles shall be cut square. Poles shall be reasonably straight, smooth and cylindrical.

A through hole of 14 mm diameter shall be provided in each pole at a height of 300 mm above the planting depth for earthing arrangements and at a distance of 150 mm from the top edge to fix the cap of the overhang bracket. The arrangements shall be got approved from the purchaser before manufacturing of the poles.

BASE PLATE

Each pole shall be provided with a galvanized steel base plate of size 250x250x6 mm.

CABLE TERMINATION & SUPPLY TO LUMINARE

Each pole shall be provided with a niche at a height of 1200 mm above the planting depth for looping in & out the main cable and also for connecting the leads of the LED fittings. The niche shall have dimensions of 300 mm along the length of the pole and width as per the outside diameter of the bottom section of the pole. The niche shall be provided with a hinged cover lockable at the centre of the free side. Suitable arrangements shall be made all around the opening so that no ingress of water shall take place from the cover. A Bakelite sheet shall be fixed inside the pole on a GI flat strip fixed to the pole.
Arrangement shall be such that removal of screw should be easy and it should not fall down. An SP-MCB, 3 Amp. Rating shall be fixed on the din rail along with four nos. 2 way connectors to accommodate 25 sq. mm Al. Cable for looping & out phase & neutral conductors. LED streetlight Luminaire fitting in the overhang bracket shall be connected with a 2.5 sq. mm Copper conductor cable in the 3rd hole of both the connectors. Adequate clearance as per relevant ISS shall be maintained. Provision to connect armour of loop in & out side of the cable to the earthing point shall be also be kept. It should be possible to isolate the external cables without disconnection. The whole arrangement should look neat & clean and shall require prior approval of the purchaser. The bought out items in this regard must be of standard and proven make and would also need approval of the purchaser.

CABLE ENTRY VIA G.I. PIPE

The underground Aluminum armoured cable of size 2c x 6 sq.mm &4Cx25 sq. mm shall be laid in the ground at a depth of 750 mm and shall be looped in & out at each pole. Suitable provision for the cable entry & exit near the bottom through GI pipe fixed at an angle of 60 degree with the vertical axis of the pole be made internal dia of GI pipe shall be of

adequate size (3 times of cable dia/min) to facilitate cable entry & exit smoothly & the GI pipe shall be welded with the pole firmly. The thickness of GI pipes shall be cut at 60° so as to form a parallel surface with the axis of the pole & surfaces smoothen properly to avoid cuts on the cable when the same is pulled through these pipes. The fixing arrangement shall be got approved before fabrication of the poles.

OVERHANG BRACKET

The roads on which these poles are proposed to be installed are about 6 m wide. An overhang of 0.75 m be provided at the top at an angle of 5° with the horizontal plan. The Galvanized pipe shall be 60 mm (max. Permitted) outside diameter & thickness not less than 3 mm. One end of the pipe shall be fixed to a pipe of bigger section of the pipe of length at least 300 mm to be fixed & slided down on the top section of the pole. This bigger section of the pipe shall act as a cap also against entry of rain water. A through hole of 14 mm dia on the top of the pole & the cap is to be provided at the suitable place in length of the cap so that the overhang bracket does not twist & change position due to the wind pressure on the brackets. The bolt, nut & washer shall from part of supply must of galvanized and of reputed make (GKW). The other free end of the overhang pole shall be made suitable to fix LED fitting of 70 W.

TOLERANCES

a) Outside Diameter

The poles shall be as nearly circular as possible and the their outside diameters shall not vary from the appropriate value. Except at the joint by more than + 1.0 percent.

b) Thickness

In the case of electrically welded tubes, the thickness of any section shall not fall below the thickness specified, by more than 10 percent.

In the case of seamless tubes, the thickness of any section shall not fall below the following tolerances:

Where the ratio of the thickness to the outside diameter is more than 3 percent, minus 12.5 percent of the specified thickness; and

Where the ratio of the thickness to the outside diameter is equal to or less than 3 percent, minus 15 percent of the specified thickness.

Length

The tolerance on the length of section shall be as follows:- On the length of sections + 40 mm
On the overall length + 25 mm

d. Weight

The mean weight for bulk supplies shall be within 92.5 percent of its calculated value. The

weight of any single pole shall not fall below the nominal weights by more than 10 percent, of that specified in IS – 2713.

c) Straightness

The finished pole shall not be out of straightness by more than 1/600 of its length.

TESTS AND RE-TESTS

The finished poles shall be subjected to the tests and re-tests in accordance with provisions of IS 2713 or other relevant standard specifications and copies of the following test certificates shall be made available to the purchaser before dispatch.

a) Deflection test
b) Permanent set test, and
c) Drop test
d) Tensile test

The purchaser may like to witness above tests for which prior 15 days' notice shall be given.

MARKING

The poles shall be marked with designation, height, strength, manufacturer's identification and date of manufacture. The poles shall also be marked with ISI certification mark. It should be identically marked and location got approved from purchaser.

A yellow line at a point 1/6 of the pole height form but end should be provided to mark the depth to which the pole should be planted inside the ground.

8. Lighting Cables & Wires

The supply & erection of power cables from distribution feeder pillars and Junction Boxes for street lighting poles shall be under the scope of this specification. Complete supply and installation of wires, conduits from lighting distribution Cabinet, Distribution Boards etc. to the individual luminaire, rocker type switch, sockets etc. are included in the scope of supply of the Supplier and built accordingly.

Lighting wires shall be 1100V grade, single core, PVC insulated, stranded conductor inner sheathed cable conforming to IS: 694, colour coded as below:

RED R- Phase

YELLOW Y-Phase

BLUE B-Phase

BLACK Neutral

GREEN Panel Earth Wire size shall be as follows:
From distribution board to lighting panel : Aluminum cable
For point wiring beyond lighting panel : Copper cable

From Junction box to fixture : Copper

9. Terminal Blocks

Multi way terminal blocks of approved type, complete with screws, nuts, washers and marking strips shall be furnished for connection of incoming/outcoming wires.

Each terminal block shall be suitable for terminating the conductors without affecting any damage to the conductor either due to bad sizing, workmanship, loose connections or any other reason.

All metal parts shall be of copper alloy, captive and touch proof. The terminal blocks shall be touch proof, suitable for Din and G-rail mounting

10. Guarantee

The Contractor shall guarantee the complete illumination work: Against defective material, design or workmanship Quality and strength of material used

Safe electrical and mechanical stresses on all specified conditions of operation Satisfactory operation during one year after commissioning and
Performance figures specified by the tenderer in the schedule of guaranteed particulars.

11. Inspection and Testing

All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and the purchaser at the time of purchase. The manufacturer shall afford the inspectors representing the purchasers all reasonable facilities, without any extra charge, to satisfy the that the material is being furnished in accordance with this specification. All the inspection and test reports, certificates shall be submitted by the supplier and got approved from the purchaser before dispatch of equipment. The inspection by the purchaser or his authorized representative shall not relieve the bidder of his obligation of furnishing equipment in accordance with the specification, and if at any it is found that equipment has not been tested as desired by Purchaser, the same would be rejected. All the expenses for inspection shall be borne by the contractor. The purchaser has right to have the test carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply. Test certificates for all bought out items shall be furnished.

Site Tests

After installation at site and after finishing all works, the site tests shall be carried out on individual equipment/system as per relevant standards.

12. Deviation from Specifications

All the deviations from the specifications shall be separately listed in specified Annexure in the absence of which it will be presumed that the provisions of the specifications have been fully complied with by the bidder.

13. Completeness of The Contract

Any fittings, accessories or apparatus which may not have been specifically mentioned in these specifications but which are usually necessary in the equipment shall be deemed to be included in the contract and shall be supplied by the supplier without extra charges. All plants and equipments shall be complete in all respects even if the details regarding all the items are not mentioned in these specifications.

14. **Compound Light Poles**

iii) The Metronomis LED poles/Post Top Light Poles shall be seamless type, and as per the specified Prefered Manufacturers. Poles shall be complete with base plate & taper plugs, and necessary pipe reducer/fixing brackets for fixing the lighting fixture and weather proof junction box etc. As depicted in the enclosed drawing.

iv) Lighting poles shall be painted with two coats of red oxide and zinc chromate in synthetic compound primer on the exposed outside surface and with bituminous paint all along the inside of the pole and outside portion which shall be embedded in foundation at manufacturing stage and additionally during installation stage.

15. Specific Technical Particulars

DIMENSION OF POST TOP LIGHT/METRONOMIS LED POLES

For the Compound lighting system, the overall length of the abovepole shall be 4.5 m as per the arrangement /Standard Manufacturers shown in enclosed figure 1.
The other important dimensions of the Galvanized poles shall be conforming to ISS 2713 and are as given below.

1.0 Name of material :4.5 mtr. Long assembly type Post Top Light Pole/Metronomis LED Poles

Technical specification	IS /IEC standard
Application type	Unless otherwise specified
Type	Assembly type swaged poles/As per Preferred Manufacturers
Overall length	4.5 mtrs.
Planting length	0.75 mtrs.

Height above the ground	3.75 mtrs.
Length of Sections	

GENREAL REQUIREMENTS

All other specification will be strictly as per Drawings and IS 2713 (Part – III) 1980.

QUALITY OF MATERIAL

All material used shall be new and of best quality and of class, most suitable for working under the conditions specified herein without distortion or deterioration.

DESIGN AND STANDARDISATION

The poles shall be designed to ensure satisfactory operation of the power system, in which continuity of service is the first consideration and shall also be designed to stand sudden load variations due to short circuits and fault conditions. The design shall incorporate all reasonable precautions and shall have necessary provision for the safety of all those concerned in the operation and maintenance of the power system.

DRAWINGS

The bidder is to submit drawings and instruction manuals along with the tender as required. However after the award of contract the detailed drawings along with necessary manuals are to be submitted (with any other particulars, the contractor may deem necessary) within 15 days for approval of purchaser. The poles shall be manufactured only after the drawings submitted by bidder have been approved by purchaser in the manner indicated therein, to incorporate the modifications suggested. The distribution shall be as in Schedule no. 9. The copies of finally in-built approved drawings shall be furnished within 15 days of the delivery of the poles.

WORKING CONDITIONS

The Compound light poles covered by these specifications shall be created for the underground street lighting system to be operated on single phase 230 volts, 50 Hz supply along roads/lanes and in hilly area. These shall, therefore, be able to withstand the weather conditions of the area and also the vibrations caused by the vehicular traffic.

PROTECTION AGAINST CORROSION

The poles (including base plate) shall be coated with conforming to relevant IS/IEC or other standard specifications internally and externally upto 500 mm above the level which goes inside the earth. The remaining portion of the exterior of the poles shall be painted with two coats of steel primer as per relevant IS/IEC or other standard specifications including over hand bracket prior to applying weather proof metallic anticorrosive paint conforming to IS 158/1983 or any other finish so asked by the purchaser. No part where a hole or cut has been made be left exposed. The final finish shall be got approved from the purchaser. Sufficient quantity of weather proof paint shall be supplied for application at site.

THE POLES MUST BE PROTECTED AGAINST ATMOSPHERIC CORROSION

The poles are to be created in an hostile atmosphere viz. Low temperature and high humidity. All exposed steel parts have a tendency to rust very quickly for which preventive measures must be provided. As indicated elsewhere all nuts, bolts, washers etc. must be galvanised properly.

MATERIAL OF POLES

The steel used for the manufacturer of poles shall be in conformity with the general requirements relating to the supply of material, as laid down in ISS 1387 or other relevant standards.
The materials, when analyzed in co-accordance with ISS 228 shall not show sulphur and phosphorous contents of more than 0.06 percent each.

The minimum tensile strength and the minimum percentage elongation of the material shall be as laid down in IS 2713 and IS: 1894 or other relevant standard specifications.

16. Constructional Details

COMPOUND LIGHT POLES

The 4.50 M high decorative compound light pole /Metronomis LED Poles in 114 mmx2.5 mm suitable for using with COB LED Pole Lamp Post Top light Poles 3x8 or 27 W or higher with Spirity Cone LED fixture - 4.5m long, As per preferred manufacturers standard having base plate, entry hole of dia from bottom and stainless steel bolt as earth terminal, suitable for single/double bracket/junction/looping box with Single Phase MCB with complete accessories which shall be got approved from the purchaser before manufacturing of poles from preferred Manufacturers. The Top length of 3 Mtrs 60mm x 2.5 mm Thickness with a reduce pipe as per required light fixture base plate 250x250x10 mm w. It shall be made suitable to fix LED fitting of 3x8 W (24 W) or higher.

Poles shall be well finish, clean and free from harmful surface defects. Ends of the poles shall be cut square. Poles shall be reasonably straight, smooth and cylindrical.

A through hole of 14 mm diameter shall be provided in each pole at a height of 300 mm above the planting depth for earthing arrangements and at a distance of 150 mm from the top edge to fix the cap of the overhang bracket. The arrangements shall be got approved from the purchaser before manufacturing of the poles.

BASE PLATE

Each pole shall be provided with a galvanized steel base plate of size as per IS/IEC standard.

CABLE TERMINATION & SUPPLY TO LUMINARE

Each pole shall be provided with a niche at a height of 750 mm above the planting depth for looping in & out the main cable and also for connecting the leads of the LED fittings. The niche shall be provided with a hinged cover lockable at the centre of the free side. Suitable arrangements shall be made all around the opening so that no ingress of water shall take place from the cover. A Bakelite sheet shall be fixed inside the pole on a GI flat strip fixed to the pole. Arrangement shall be such that removal of screw should be easy and it should not fall down. An SP-MCB, 3 Amp. Rating shall be fixed on the din rail along with four nos. 2 way connectors to accommodate 10 & 16 sq. mm Al. Cable for looping & out phase & neutral conductors. LED post Top fitting in the shall be connected with a 2.5 sq. mm Copper conductor cable in the 3rd hole of both the connectors. Adequate clearance as per relevant ISS shall be maintained. Provision to connect armour of loop in & out side of the cable to the earthing point shall be also be kept. It should be possible to isolate the external cables without disconnection. The whole arrangement should look neat & clean and shall require prior approval of the purchaser. The bought out items in this regard must be of standard and proven make and would also need approval of the purchaser.

CABLE ENTRY VIA G.I. PIPE

The underground Aluminum armoured cable of size 2Cx6 & 2cx 10, sq. mm shall be laid in the ground at a depth of 750 mm and shall be looped in & out at each pole. Suitable provision for the cable entry & exit near the bottom through Junction box size of 240x130x 110 mm with the provision of to facilitate cable entry & exit smoothly & the GI pipe shall be welded with the pole firmly. The thickness of GI pipes shall be cut at 60° so as to form a parallel surface with the axis of the pole & surfaces smoothen properly to avoid cuts on the cable when the same is pulled through these pipes. The fixing arrangement shall be got approved before fabrication of the poles.

The pole shall be made suitable to fix LED Post Top fitting of 3x8W (24 W) or higher including junction box and the terminal blocks with all connection and accessories.

TOLERANCES

a) Outside Diameter

The poles shall be as nearly circular as possible and the their outside diameters shall not vary from the appropriate value. Except at the joint by more than + 1.0 percent.

b) Thickness

In the case of electrically welded tubes, the thickness of any section shall not fall below the thickness specified, by more than 10 percent.

In the case of seamless tubes, the thickness of any section shall not fall below the following tolerances:

Where the ratio of the thickness to the outside diameter is more than 3 percent, minus 12.5 percent of the specified thickness; and

Where the ratio of the thickness to the outside diameter is equal to or less than 3 percent, minus 15 percent of the specified thickness.

Length

The tolerance on the length of section shall be as follows:- On the length of sections + 40 mm
On the overall length + 25 mm

d. Weight

The mean weight for bulk supplies shall be within 92.5 percent of its calculated value. The weight of any single pole shall not fall below the nominal weights by more than 10 percent, of that specified in IS – 2713.

c) Straightness

The finished pole shall not be out of straightness by more than 1/600 of its length.

TESTS AND RE-TESTS

The finished poles shall be subjected to the tests and re-tests in accordance with provisions of IS 2713 or other relevant standard specifications and copies of the following test certificates shall be made available to the purchaser before dispatch.

a) Deflection test
b) Permanent set test, and
c) Drop test
d) Tensile test

The purchaser may like to witness above tests for which prior 15 days' notice shall be given.

MARKING

i. The poles shall be marked with designation, height, strength, manufacturer's identification and date of manufacture. The poles shall also be marked with ISI certification mark. It should be identically marked and location got approved from purchaser.

ii. A yellow line at a point 1/6 of the pole height form but end should be provided to mark the depth to which the pole should be planted inside the ground.

17. Lighting Cables & Wires

The supply & erection of power cables from distribution feeder pillars and Junction Boxes for street lighting poles shall be under the scope of this specification. Complete supply and installation of wires, conduits from lighting distribution Cabinet, Distribution Boards etc. to the individual luminaire, rocker type switch, sockets etc. are included in the scope of supply of the

Supplier.

Lighting wires shall be 1100V grade, single core, PVC insulated, stranded conductor inner sheathed cable conforming to IS: 694, colour coded as below:

RED R- Phase

YELLOW Y-Phase

BLUE B-Phase

BLACK Neutral

GREEN Panel Earth Wire size shall be as follows:
From distribution board to lighting panel : Aluminum cable
For point wiring beyond lighting panel : Copper cable
From Junction box to fixture : Copper

18. Terminal Blocks

Multi way terminal blocks of approved type, complete with screws, nuts, washers and marking strips shall be furnished for connection of incoming/outcoming wires.

Each terminal block shall be suitable for terminating the conductors without affecting any damage to the conductor either due to bad sizing, workmanship, loose connections or any other reason.

All metal parts shall be of copper alloy, captive and touch proof. The terminal blocks shall be touch proof, suitable for Din and G-rail mounting

19. Guarantee

The Contractor shall guarantee the complete illumination work: Against defective material, design or workmanship Quality and strength of material used

Safe electrical and mechanical stresses on all specified conditions of operation Satisfactory operation during Three years after commissioning and Performance figures specified by the tenderer in the schedule of guaranteed particulars.

20. Inspection and Testing

All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and the purchaser at the time of purchase. The manufacturer shall afford the inspectors representing the purchasers all reasonable facilities, without any extra charge, to satisfy them that the material is being furnished in accordance with this specification.
As far as factory inspection is concerned, it will happen only at the time of delivery which will be about 11 months from the LOA. At that time if COVID 19 situation goes away we can carry out

factory inspection. If situation does not improve we can either do it with tests through virtual link or inspect it after decontamination at the Border to ensure the quality.

All the inspection and test reports, certificates shall be submitted by the supplier and got approved from the purchaser before dispatch of equipment. The inspection by the purchaser or his authorized representative shall not relieve the bidder of his obligation of furnishing equipment in accordance with the specification, and if at any it is found that equipment has not been tested as desired by Purchaser, the same would be rejected. All the expenses related for inspection shall be borne by the contractor. The purchaser has right to have the test carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply. Test certificates for all bought out items shall be furnished.

Site Tests

After installation at site and after finishing all works, the site tests shall be carried out on individual equipment/system as per relevant standards.

21. Deviation from Specifications

All the deviations from the specifications shall be separately listed in specified Annexure in the absence of which it will be presumed that the provisions of the specifications have been fully complied with by the bidder.

22. Completeness of The Contract

Any fittings, accessories or apparatus which may not have been specifically mentioned in these specifications but which are usually necessary in the equipment shall be deemed to be included in the contract and shall be supplied by the supplier without extra charges. All plants and equipments shall be complete in all respects even if the details regarding all the items are not mentioned in these specifications.

23. GUARANTEED TECHNICAL PARTICULARS

The Bidder shall submit guaranteed & technical particulars of the equipment as per the specification in Annexures.

(Note: All the details need to be dully filled up in the schedules and GTP. If any technical deviation may kindly be indicated in the Schedule part or require any site visit)

Inverter
Hi-Wall Split Air conditioner (With R410A Environment Friendly Refrigerant)

All split air conditioners consist of two main components, the **Indoor Unit (IDU)** and the **Outdoor Unit (ODU)**. While the former is installed inside the air condition room, the latter is kept outside. This is because all the heat from inside is rejected outside through the ODU.

The ODU houses the all-important part of your air conditioner the compressor.

The IDU is mounted on one of the Walls of the room to be airconditioned. The ODU can be mounted on a Wall, sunshade or skirting, outside the room. The two units are connected through refrigerant pipes made of copper.

Inverter Technology

Normal Split ACs have fixed speed compressors (they work on Fixed RPM, Fixed Frequency i.e., 50Hz), But Inverter Compressors can change their frequency from low to high. Herein, Ambient Load & Room Load is accounted for consistently. As the frequency changes, RPM of the compressor changes. The Compressor/AC uses its full capacity at start to quickly reach the set temperature. As soon as the AC reaches the set temperature, it adjusts the capacity to eliminate any temperature fluctuations & maintain the comfort.

Heat Pump, model will provide warm environment during winter.

Inverter units are charged with R410A refrigerant the new environment friendly refrigerant, which has almost nil ozone depleting.

SCHEDULE OF RECOMMENDED TOOLS

Sl. No.	Item / Description	Make	Unit	Qty.
1		3	4	5
II.				

Place :

SIGNATURE OF TENDERER

Date :

Stamp

SCHEDULE OF INSPECTION AND TESTS

Sl. No.	Description	Remarks
1	2	3
A.	Tests & Inspection at works	
B.	Tests & Inspection at site	

Place :

SIGNATURE OF TENDERER

Date :

Stamp

SCHEDULE OF DRAWINGS, CATALOGUES AND MANUALS

Sl. No.	Description	Remarks
1	2	3

Place :

SIGNATURE OF TENDERER

Stamp

Date :

SCHEDULE OF DEVIATIONS FROM SPECIFICATIONS

Sl. No	Specification / Clause	Deviation from Specification	Justification for deviation
1	2	3	4

Place :

SIGNATURE OF TENDERER

Date :

Stamp

SCHEDULE OF DELIVERY AND COMPLETION PERIOD

Sl. No.	Description	Period in months
1	2	3

Place :

SIGNATURE OF TENDERER

Date :

Stamp

LIST OF PREFERRED EQUIPMENT MANUFACTURERS

SL.	DESCRIPTION	PREFERRED MAKES
1	UNITIZED PACKAGED SUBSTATION COMPRISING OF THE FOLLOWING MAJOR ITEMS.	AREVA / ABB/ SCHNEIDER/ALSTOM/C&S/SIEMENS
	a) DISTRIBUTION TRANSFORMER (33/0.415kV)	AREVA/CGL/VOLTAMP/VIJAY /ALSTOM/ CROMPTON GEAVES LTD/KOTS(/SCHNEIDER/ABB
	b) LOAD BREAK SWITCH	ABB/SIEMENS/AREVA/CGL/SCHNEIDER
	c) VACUUM CIRCUIT BREAKER	ABB/SIEMENS/AREVA/CGL/BHEL/SCHNEIDER
	d) L.T. PANEL	CONTROL & SWITCHGEAR/L&T/ABB/SCHNEIDER/ AREVA
	e) AIR CIRCUIT BREAKER	L&T/SIEMENS/AREVA/ABB/SCHNEIDER/ALSTOM
	f) MCCBs	L&T/SIEMENS/AREVA/CGL/SCHNEIDER/ LEGRAND
	g) MCBs	LEGRAND (LEXIC)/ABB/ SIEMENS/SCHENEIDER/ L&T/ABB
	h) CTs, PTs and CVTs	ABB/CGL/BHEL/SIEMENS/AREVA
	i) CONTROL & RELAY PANELS	ABB/ALSTOM/SIEMENS
	j) PROTECTIVE REPAYS	ABB/SIEMENS/AREVA/SCHNEIDER
	k) ENERGY METERS	SECURE/L&T/AREVA/HAVELS
	l) CONTACTOR	L&T/ABB/SIEMENS/SCHNEIDER/AND EQUIVALENT

	m) RELAY	AREVA/ABB/SIEMENS
	n) SELECTOR SWITCH	AREVA/KAYCEE/RECOM/SIEMENS/L&T
	o) VOLTMETER/AMMETER	AE/MECO/RISHAB
2	FEEDER/STREET LIGHT PILLARS	CONTROL & SWITCHGEAR/L&T/SCHNEIDER/ AREVA
3	ISOLATORS	SIEMENS/S&S/GE POWER
5	HT, LT and CONTROL CABLES	HAVELS /FINOLEX CABLE/POLY CABLE INDIA LTD/RR CABLE/RPG/V GUARD/STERILITE TECH CABLES/SYSKA WIRES/KEI INDUSTRIES/RICHA CABLES/CRYSTAL CABLE
6	HT, LT TERNIMATION KITS	RAYCHEM/CABLE ACCESSORIES PVT LTD/DENSONS /DULMISION/VENUS CABLES JOINTS/CABLE ACCESSORIES LTD
7	LIGHTING SYSTEM	PHILLIPS/CGL/OSRAM/HAVELLS/GE
8	STEEL TUBULAR POLES SWAGED POLE, CROSS ARM and POLE ACCESSORIES.	BAJAJ ELECTRICALS/TECHNO-ELECTRIC/RELIABLE STEEL/IGNITE ELECTRONICS/UTKAL GALVANISERS/AMITASHA/SANGAM STRUCTURAL/CALCUTTA POLES/OCTOGONAL POLE
9	COMPOUND POST TOP LIGHT POLES	HAVELLS/PHILLIPS/WIPRO/BAJAJELECTRICALS/CGL/JAQUAR/ELECTOLIT CTRO FITTING & EQUIPMENTS

Annexure

1 ENCLOSURE FOR PACKAGED SUB-STATION

Sl. No.	Description	Unit	Guaranteed Particulars
1	Name of manufacturer		
2	IS/IEC Standard		
3	No. of Compartments & size of each compartment		
a)	Transformer		
b	HV compartment		
c)	LV compartment		
4	Dimension of the Enclosure		
a)	Length (mm)		
b)	Breadth (mm)		
c)	Width (mm)		
d)	Height (mm)		
5	Weight of the complete enclosure		
6	Thickness of Sheet Steel		
a)	Base Plate (mm)		
b)	Side Walls (mm)		
c)	Roof (mm)		
d)	Doors (mm)		
7	Any Stiffners used for giving Extra Strength to Side sheets (Yes/No)		
8	Whether roof of the enclosure is slanting to avoid accumulation of water (Yes/No)		
9	Degree of Protection of the enclosure :		
a)	HV compartment		
b)	LV compartment		
c)	Transformer compartment		
10	Whether Vermin/Dust Proof (Yes/No)		
11	Arrangement of Ventilation of Hot air (Yes/No)		
12	Whether space heater provided with thermostat in each compartment (Yes/No)		
13	Wattage of the each space heater (Yes/No)		
14	Whether Lighting arrangement inside the enclosure provided (Yes/No)		
15	Wattage of the Lighting Fixtures		

Sl. No.	Description	Unit	Guaranteed Particulars
16	Provision of doors for access to each equipment		
a)	12 kV RMU		
b)	Transformer		
c)	LT Switchboard		
17	Details of galvanising/Painting		
a)	Exteriors		
b)	Interiors		
18	Details of Fixing/Grouting arrangement of the Enxlosure		
19	Earthing details of the Enclosure		
20	Danger board provided outside the enclosure (Yes/No)		
21	Lifting arrangement of the enclosure		
22	Provision of safety equipment details		
a)	Fire fighting		
b)	Shock treatment chart		
c)	Rubber Mat		
d)	First aid Box		
23	Arrangement for the collection of rain water from the roof top		
24	Cable Entry arrangement in the enclosure for each compartment		
25	Is provision provided for drawing of oil in case of fire		

Signature:

Seal:

2 POWER TRANSFORMER

Sl. No.	Description	Unit	500 kVA	
			Oil	Dry
1	Name of the Manufacturer and Country.			
2	Governing standard			
3	Service			
4	Rated frequency	(Hz)		
5	No. of phases	(Nos.)		
6	Type of cooling			
7	No. of windings	(Nos.)		
8	Rating			
9	Rated voltages			
	a) HV	(kV)		
	b) LV	(kV)		
10	Connection Symbol.			
11	Temperature rise of oil above reference peak ambient temperature	(Deg. C)		
12	Temperature rise of windings, above reference peak ambient temperature	(Deg. C)		
13	Temperature gradient between windings and oil.	(Deg. C)		
14	Limit of hot spot temperature for which the transformer is designed	(Deg. C)		
15	a)Guaranteed no load losses at rated voltage, normal ratio and rated frequency and 75 Degree Centigrade average winding temperature.	(kW)		
	b)State whether the losses are firm or subject to tolerance. In a case it is subject to tolerance indicate the ceiling for tolerance.	(%)		
16	a)Guaranteed load losses at rated output, rated frequency, corrected for 75 degree centigrade winding temperature for the:			
17	i)Principal Tap	(kW)		
	ii)Lowest tap	(kW)		
	iii)Highest tap	(kW)		
	b)State whether the losses are firm or subject to tolerance. In a case it is subject to tolerance indicate the ceiling for tolerance.	(%)		
	State whether the losses are firm or subject to tolerance. In case it is subject to tolerance indicate the ceiling for tolerance.	(kW)		
18	Withstand time for three phase short circuit at terminals	(Sec)		
19	Capacitance to earth for HV and LV	(pF, pu)		
20	Efficiency at 75 Degree centigrade winding temperature at Unity Power Factor (UPF) and 0.85 PF (lagging)			

Sl. No.	Description	Unit	500 kVA	
	a)On 100% Load	(%)		
	b)On 75% Load	(%)		
	c)On 50% Load	(%)		
21	Regulation at full load at 75 Degree centigrade expressed as a percentage of normal voltage, at			
	a)Unity power factor	(%)		
	b)0.85 power factor (Lagging)	(%)		
22	Core data			
	a)Material for core laminations.			
	b)Thickness of laminations	(mm)		
	c)Insulation between core lamination			
	d)Insulation of core bolts, washers, end plates etc.			
	e)Maximum flux density in steel at rated voltage, frequency and at 90%, 100% and 110% voltage	(Tesla)		
	f)Number of limbs of the core.			
	g)Magnetizing inrush current	(mA)		
	h)No-load current at normal ratio and frequency for			
	(i) 85 Percent of rated voltage	(Amp)		
	(ii) 100 Percent of rated voltage	(Amp)		
	(iii) 105 Percent of rated voltage	(Amp)		
23	Data on windings			
	i) Maximum current density at CMR and conductor area			
	a) HV	(A/sq. mm)		
	b) LV	(A/sq. mm)		
	ii) Conductor material			
	a) HV			
	b) LV			
	iii) Insulating material used for			
	a) HV winding/LV Winding			
	iv) Insulating material used between			
	a) HV and LV winding			

Sl. No.	Description	Unit	500 kVA	
	b) LV winding and core			
	v) Details of special arrangement provided to improve surge voltage distribution in the winding.			
	vi) Whether HV winding interleaved	(Yes/No)		
	vii) Position of tapping on the winding			
	viii) Maximum current density under short circuit			
	a) HV	(A/sq. mm)		
	b) LV	(A/sq. mm)		
24	Test Voltages			
	i) Lightning withstand test voltage	(kV peak)		
	ii) Power frequency withstand test voltage	(kV rms)		
	iii) Switching surge withstand voltage	(kV peak)		
25	Partial discharge level	(pC)		
26	Noise level when energized at normal voltage and frequency without load	(dB)		
27	Off-Load tap changing Gear			
	a) Make and type			
	b) Rated current	(Amp)		
	c) Rated voltage	(Volts)		
	d) Number of steps	(Nos.)		
	e) Step voltage	(Volts)		
	f) Time taken to change one step	(Sec)		
28	Bushings			
	a) Make and type			
	b) Rated current	(Amp)		
	c) Distance in air	(mm)		
	d) Weight of assembled bushing	(Kg)		
	e) Whether terminal connector for all bushings included in the scope of supply	(Yes/No)		
29	Tank			
	a) Material and thickness of plate for tank construction			
	b) Tank cover conventional or Bell type			
	c) No. of Pressure relief devices provided			
30	Vacuum withstand capacity of			
	a) Main tank	(mm Hg)		
	b) Radiators and accessories	(mm Hg)		
31	Pressure withstand capacity of			
	a) Main tank	(kN/sq. m)		
	b) Radiators and accessories	(kN/sq. m)		
32	Oil			
	a) Quantity of oil (Before filling & Before commissioning)	(litres)		
	b) Moisture content	(%)		
	c) Tan delta at 90 Degrees centigrade			
	d) Resistivity	(Ohm-cm)		
	e) Breakdown strength	(kV)		
	f) Quantity supplied	(litres)		

Sl. No.	Description	Unit	500 kVA	
	g) Applicable standard			
33	Temperature Indicators			
	a) OTI			
	i)Range			
	ii)Accuracy			
	b) WTI			
	i)Range			
	ii)Accuracy			
34	Weights and Dimensions			
	i) Weights			
	a) Core	(Kg)		
	b) Windings	(Kg)		
	c) Tank	(Kg)		
	d) Fittings	(Kg)		
	e) Oil	(Kg)		
	f) Total weights of complete transformers with oil and fittings	(Kg)		
	ii) Dimensions			
	a) Overall Height above track	(mm)		
	b) Overall length	(mm)		
	c) Overall breadth	(mm)		

(N.A.) be written against the item which is not applicable.

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Seal:

Sl. No.	Description	Unit	500 kVA

3 ISOLATORS / DISCONNECTORS AND EARTHING

Sl. No.	Description	Unit	Specific Requirements
			2 Pole
1	Manufacturer's Name and Country		
2	Type Designation		
3	Applicable standard		IEC: 129/IS: 9921
4	Type - (Outdoor/Indoor)		Outdoor
5	Rated voltage	(kV)	52
6	Rated frequency	(Hz)	50
7	No. of Poles	(Nos.)	2
8	Whether all three poles are ganged together mechanically/electrically	(Yes/No)	
9	Rated normal current		
a)	Under site conditions	(Amp)	2500
b)	Under normal conditions as per IS/IEC	(Amp)	2500
10	Rated short time current for 1 Sec.	(kA rms)	40
11	Rated peak short circuit current of		
a)	Isolator	(kA peak)	63
b)	Earthing switch	(kA peak)	63
12	Rated short circuit making current	(kA)	
13	Rated magnetizing current and capacitive current make and break capacity	(Amp)	0.7 at 0.15 p.f.
14	Temperature rise over ambient temperature at site corresponding to		
a)	Maximum continuous current	(Deg. C)	As per IS:9921/ IEC:129/ IEC:694
b)	Short time current	(Deg. C)	
15	Rated Insulation levels		
a)	1.2/50 microsecond lightning impulse withstand voltage		
	i) to earth	(kV peak)	250
	i) across the open isolator		
	- one terminal lightning impulse	(kV peak)	290
	- opposite terminal power frequency	(kV peak)	-

3 ISOLATORS / DISCONNECTORS AND EARTHING SWITCHES

Sl. No.	Description	Unit	Specific Requirements	Guaranteed
			2 Pole	
1	Manufacturer's Name and Country			
2	Type Designation			
3	Applicable standard		IEC: 129/IS: 9921	
4	Type - (Outdoor/Indoor)		Outdoor	
5	Rated voltage	(kV)	52	
6	Rated frequency	(Hz)	50	
7	No. of Poles	(Nos.)	2	
8	Whether all three poles are ganged together mechanically/electrically	(Yes/No)		
9	Rated normal current			
a)	Under site conditions	(Amp)	2500	
b)	Under normal conditions as per IS/IEC	(Amp)	2500	
10	Rated short time current for 1 Sec.	(kA rms)	40	
11	Rated peak short circuit current of			
a)	Isolator	(kA peak)	63	
b)	Earthing switch	(kA peak)	63	
12	Rated short circuit making current	(kA)		
13	Rated magnetizing current and capacitive current make and break capacity	(Amp)	0.7 at 0.15 p.f.	
14	Temperature rise over ambient temperature at site corresponding to			
a)	Maximum continuous current	(Deg. C)	As per IS:9921/ IEC:129/ IEC:694	
b)	Short time current	(Deg. C)		
15	Rated Insulation levels			
a)	1.2/50 microsecond lightning impulse withstand voltage			
	i) to earth	(kV peak)	250	
	i) across the open isolator			
	- one terminal lightning impulse	(kV peak)	290	
	- opposite terminal power frequency	(kV peak)	-	

3 ISOLATORS / DISCONNECTORS AND EARTHING

Sl. No.	Description	Unit	Specific Requirements	Particulars
			2 Pole	
1	Manufacturer's Name and Country			
2	Type Designation			
3	Applicable standard		IEC: 129/IS: 9921	
4	Type - (Outdoor/Indoor)		Outdoor	
5	Rated voltage	(kV)	52	
6	Rated frequency	(Hz)	50	
7	No. of Poles	(Nos.)	2	
8	Whether all three poles are ganged together mechanically/electrically	(Yes/No)		
9	Rated normal current			
a)	Under site conditions	(Amp)	2500	
b)	Under normal conditions as per IS/IEC	(Amp)	2500	
10	Rated short time current for 1 Sec.	(kA rms)	40	
11	Rated peak short circuit current of			
a)	Isolator	(kA peak)	63	
b)	Earthing switch	(kA peak)	63	
12	Rated short circuit making current	(kA)		
13	Rated magnetizing current and capacitive current make and break capacity	(Amp)	0.7 at 0.15 p.f.	
14	Temperature rise over ambient temperature at site corresponding to			
a)	Maximum continuous current	(Deg. C)	As per IS:9921/ IEC:129/ IEC:694	
b)	Short time current	(Deg. C)		
15	Rated Insulation levels			
a)	1.2/50 microsecond lightning impulse withstand voltage			
	i) to earth	(kV peak)	250	
	i) across the open isolator			
	- one terminal lightning impulse	(kV peak)	290	
	- opposite terminal power frequency	(kV peak)	-	

Sl. No.	Description	Unit	Specific Requirements
			2 Pole
b)	250/2500 microsecond switching impulse withstand voltage		
	i) to earth	(kV peak)	NA
	ii) Across the open isolator		
	- one terminal switching impulse	(kV peak)	NA
	- opposite terminal power frequency	(kV peak)	NA
c)	1 minute power frequency withstand voltage		
	i) to earth	(kV rms)	95
	ii) across the terminal of open isolator	(kV rms)	110
16	Rated mechanical terminal loads for horizontal break isolator		
a)	Longitudinal	(N)	400
b)	Transverse	(N)	130
17	Total operating time		
a)	Opening time	(Sec)	< 12
b)	Closing time	(Sec)	< 12
18	Main contacts (fixed and moving)		
a)	Type		High Pressure
b)	Material		Electrolytic Cu strip
c)	Whether contacts are silver plated	(Yes/No)	
d)	Thickness of silver coating	(mm)	>25 microns
e)	Contact area	(Sq. mm)	
f)	Contact pressure	(kg/sq. cm)	
g)	Current density		
h)	Number of operations which the isolator can make without	(Nos.)	
i)	Whether arcing contacts provided and if so give type and material used.	(Yes/No)	
19	Insulators		
a)	Make		
b)	Type (solid core)		Solid Core
c)	Applicable Standard		IS:2544 / IEC:168 /
d)	Number of insulator stacks per pole	(Nos.)	
e)	Number of insulators per stack	(Nos.)	
f)	1 minute power frequency withstand voltage	(kV rms)	95
g)	Lightning impulse withstand voltage	(kV peak)	250
h)	Switching impulse withstand voltage	(kV peak)	NA

Sl. No.	Description	Unit	Specific Requirements	Guaranteed
			2 Pole	
b)	250/2500 microsecond switching impulse withstand voltage			
	i) to earth	(kV peak)	NA	
	ii) Across the open isolator			
	- one terminal switching impulse	(kV peak)	NA	
	- opposite terminal power frequency	(kV peak)	NA	
c)	1 minute power frequency withstand voltage			
	i) to earth	(kV rms)	95	
	ii) across the terminal of open isolator	(kV rms)	110	
16	Rated mechanical terminal loads for horizontal break isolator			
a)	Longitudinal	(N)	400	
b)	Transverse	(N)	130	
17	Total operating time			
a)	Opening time	(Sec)	< 12	
b)	Closing time	(Sec)	< 12	
18	Main contacts (fixed and moving)			
a)	Type		High Pressure	
b)	Material		Electrolytic Cu strip	
c)	Whether contacts are silver plated	(Yes/No)		
d)	Thickness of silver coating	(mm)	>25 microns	
e)	Contact area	(Sq. mm)		
f)	Contact pressure	(kg/sq. cm)		
g)	Current density			
h)	Number of operations which the isolator can make without	(Nos.)		
i)	Whether arcing contacts provided and if so give type and material used.	(Yes/No)		
19	Insulators			
a)	Make			
b)	Type (solid core)		Solid Core	
c)	Applicable Standard		IS:2544 / IEC:168 /	
d)	Number of insulator stacks per pole	(Nos.)		
e)	Number of insulators per stack	(Nos.)		
f)	1 minute power frequency withstand voltage	(kV rms)	95	
g)	Lightning impulse withstand voltage	(kV peak)	250	
h)	Switching impulse withstand voltage	(kV peak)	NA	

Sl. No.	Description	Unit	Specific Requirements	Particulars
			2 Pole	
b)	250/2500 microsecond switching impulse withstand voltage			
	i) to earth	(kV peak)	NA	
	ii) Across the open isolator			
	- one terminal switching impulse	(kV peak)	NA	
	- opposite terminal power frequency	(kV peak)	NA	
c)	1 minute power frequency withstand voltage			
	i) to earth	(kV rms)	95	
	ii) across the terminal of open isolator	(kV rms)	110	
16	Rated mechanical terminal loads for horizontal break isolator			
a)	Longitudinal	(N)	400	
b)	Transverse	(N)	130	
17	Total operating time			
a)	Opening time	(Sec)	< 12	
b)	Closing time	(Sec)	< 12	
18	Main contacts (fixed and moving)			
a)	Type		High Pressure	
b)	Material		Electrolytic Cu strip	
c)	Whether contacts are silver plated	(Yes/No)		
d)	Thickness of silver coating	(mm)	>25 microns	
e)	Contact area	(Sq. mm)		
f)	Contact pressure	(kg/sq. cm)		
g)	Current density			
h)	Number of operations which the isolator can make without	(Nos.)		
i)	Whether arcing contacts provided and if so give type and material used.	(Yes/No)		
19	Insulators			
a)	Make			
b)	Type (solid core)		Solid Core	
c)	Applicable Standard		IS:2544 / IEC:168 /	
d)	Number of insulator stacks per pole	(Nos.)		
e)	Number of insulators per stack	(Nos.)		
f)	1 minute power frequency withstand voltage	(kV rms)	95	
g)	Lightning impulse withstand voltage	(kV peak)	250	
h)	Switching impulse withstand voltage	(kV peak)	NA	

Sl. No.	Description	Unit	Specific Requirements	Particulars
			2 Pole	
i)	Visible corona extinction voltage	(kV rms)	-	
j)	Creepage distance	(mm)	1300	
k)	Weight of each post insulator per	(Kg)		
l)	Tensile strength	(Kg)		
m)	Compressive strength	(Kg)		
n)	Torsional strength	(Kg-m)		
o)	Cantilever strength	(Kg)		
p)	Bolt circle dia	(mm)		
20	Minimum phase to phase clearance	(mm)	2000	
21	a) Minimum phase to ground	(mm)		
	b) Minimum distance between phases when isolator is open	(mm)		
22	Types of bearings			
23	Locations of bearings			
24	Type of lubricant for bearings			
25	Terminal Clamps & Connectors			
a)	Manufacturer's name			
b)	Applicable standard		IS:5561	
c)	Material			
	i) Clamp body			
	ii) Bolts and nuts			
	iii) Spring washer			
	iv) Liners if any			
d)	Rated current	(Amp)	2500	
e)	Rated terminal load	(Kg)	100 (Static)	
f)	Weight of clamp complete with	(Kg)		
26	Operating Mechanism			
a)	Type of operating mechanism		Manual	
b)	Name of manufacturer			
c)	Type of manual operating mechanism for isolator pole			
d)	Force required to operate manual operating mechanism	(Kg)		
e)	Whether padlocking included as per the specification	(Yes/No)		
f)	Type of manual device for Earthing			
g)	Force required to operate manual device for earthing switch	(Kg)		
27	Interlocking			
a)	Details of mechanical interlock between isolator and earth switch	(Yes/No)		

Sl. No.	Description	Unit	Specific Requirements
			2 Pole
28	Size and Weight		
a)	Weight of each pole	(Kg)	
b)	Space requirement i.e. length.	(mm)	
c)	Height of 3 phase isolator without earth switch.	(mm)	
d)	Dimension of the isolators		
	i) without earthing switch	(mm x mm x mm)	
	ii) with earth switch on one side	(mm x mm x	
29	Enclosures		
	Whether the following are enclosed		
	i) Type test report for main equipment and auxiliaries	(Yes/No)	
	ii) Drawings as per specification	(Yes/No)	
	iii) Technical literature for isolator, operating mechanism and support insulators.	(Yes/No)	
30	**A. Tandem Pipe**		
	a) Size (internal diameter)	(mm)	25
	b) Class		B
	c) Material		GI
	B. Down pipe		
	a) Internal dia.	(mm)	50
	b) Class		B
	c) Material		GI

Note (N.A.) be written against the item which is not applicable.

Sl. No.	Description	Unit	Specific Requirements	Guaranteed
			2 Pole	
28	Size and Weight			
a)	Weight of each pole	(Kg)		
b)	Space requirement i.e. length.	(mm)		
c)	Height of 3 phase isolator without earth switch.	(mm)		
d)	Dimension of the isolators			
	i) without earthing switch	(mm x mm x mm)		
	ii) with earth switch on one side	(mm x mm x		
29	Enclosures			
	Whether the following are enclosed			
	i) Type test report for main equipment and auxiliaries	(Yes/No)		
	ii) Drawings as per specification	(Yes/No)		
	iii) Technical literature for isolator, operating mechanism and support insulators.	(Yes/No)		
30	**A. Tandem Pipe**			
	a) Size (internal diameter)	(mm)	25	
	b) Class		B	
	c) Material		GI	
	B. Down pipe			
	a) Internal dia.	(mm)	50	
	b) Class		B	
	c) Material		GI	

lote (N.A.) be written against the item which is not applicable.

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Sl. No.	Description	Unit	Specific Requirements	Particulars
			2 Pole	
28	Size and Weight			
a)	Weight of each pole	(Kg)		
b)	Space requirement i.e. length.	(mm)		
c)	Height of 3 phase isolator without earth switch.	(mm)		
d)	Dimension of the isolators			
	i) without earthing switch	(mm x mm x mm)		
	ii) with earth switch on one side	(mm x mm x		
29	Enclosures			
	Whether the following are enclosed			
	i) Type test report for main equipment and auxiliaries	(Yes/No)		
	ii) Drawings as per specification	(Yes/No)		
	iii) Technical literature for isolator, operating mechanism and support insulators.	(Yes/No)		
30	**A. Tandem Pipe**			
	a) Size (internal diameter)	(mm)	25	
	b) Class		B	
	c) Material		GI	
	B. Down pipe			
	a) Internal dia.	(mm)	50	
	b) Class		B	
	c) Material		GI	

lote (N.A.) be written against the item which is not applicable.

3 ISOLATORS / DISCONNECTORS AND EARTHING SWITCHES

Sl. No.	Description	Unit	Specific Requirements	Guaranteed Particulars
			2 Pole	
1	Manufacturer's Name and Country			
2	Type Designation			
3	Applicable standard		IEC: 129/IS: 9921	
4	Type - (Outdoor/Indoor)		Outdoor	
5	Rated voltage	(kV)	52	
6	Rated frequency	(Hz)	50	
7	No. of Poles	(Nos.)	2	
8	Whether all three poles are ganged together mechanically/electrically	(Yes/No)		
9	Rated normal current			
a)	Under site conditions	(Amp)	2500	
b)	Under normal conditions as per IS/IEC	(Amp)	2500	
10	Rated short time current for 1 Sec.	(kA rms)	40	
11	Rated peak short circuit current of			
a)	Isolator	(kA peak)	63	
b)	Earthing switch	(kA peak)	63	
12	Rated short circuit making current	(kA)		
13	Rated magnetizing current and capacitive current make and break capacity	(Amp)	0.7 at 0.15 p.f.	
14	Temperature rise over ambient temperature at site corresponding to			
a)	Maximum continuous current	(Deg. C)	As per IS:9921/ IEC:129/	
b)	Short time current	(Deg. C)		
15	Rated Insulation levels			
a)	1.2/50 microsecond lightning impulse withstand voltage			
	i) to earth	(kV peak)	250	
	i) across the open isolator			
	- one terminal lightning impulse	(kV peak)	290	
	- opposite terminal power frequency	(kV peak)	-	

Sl. No.	Description	Unit	Specific Requirements	Guaranteed Particulars
			2 Pole	
b)	250/2500 microsecond switching impulse withstand voltage			
	i) to earth	(kV peak)	NA	
	ii) Across the open isolator			
	- one terminal switching impulse	(kV peak)	NA	
	- opposite terminal power frequency	(kV peak)	NA	
c)	1 minute power frequency withstand voltage			
	i) to earth	(kV rms)	95	
	ii) across the terminal of open isolator	(kV rms)	110	
16	Rated mechanical terminal loads for horizontal break isolator			
a)	Longitudinal	(N)	400	
b)	Transverse	(N)	130	
17	Total operating time			
a)	Opening time	(Sec)	< 12	
b)	Closing time	(Sec)	< 12	
18	Main contacts (fixed and moving)			
a)	Type		High Pressure	
b)	Material		Electrolytic Cu strip	
c)	Whether contacts are silver plated	(Yes/No)		
d)	Thickness of silver coating	(mm)	>25 microns	
e)	Contact area	(Sq. mm)		
f)	Contact pressure	(kg/sq. cm)		
g)	Current density			
h)	Number of operations which the isolator can make without	(Nos.)		
i)	Whether arcing contacts provided and if so give type and material used.	(Yes/No)		
19	Insulators			
a)	Make			
b)	Type (solid core)		Solid Core	
c)	Applicable Standard		IS:2544 / IEC:168 /	
d)	Number of insulator stacks per pole	(Nos.)		
e)	Number of insulators per stack	(Nos.)		
f)	1 minute power frequency withstand voltage	(kV rms)	95	
g)	Lightning impulse withstand voltage	(kV peak)	250	
h)	Switching impulse withstand voltage	(kV peak)	NA	

Sl. No.	Description	Unit	Specific Requirements	Guaranteed Particulars
			2 Pole	
i)	Visible corona extinction voltage	(kV rms)	-	
j)	Creepage distance	(mm)	1300	
k)	Weight of each post insulator per	(Kg)		
l)	Tensile strength	(Kg)		
m)	Compressive strength	(Kg)		
n)	Torsional strength	(Kg-m)		
o)	Cantilever strength	(Kg)		
p)	Bolt circle dia	(mm)		
20	Minimum phase to phase clearance	(mm)	2000	
21	a) Minimum phase to ground	(mm)		
	b) Minimum distance between phases when isolator is open	(mm)		
22	Types of bearings			
23	Locations of bearings			
24	Type of lubricant for bearings			
25	Terminal Clamps & Connectors			
a)	Manufacturer's name			
b)	Applicable standard		IS:5561	
c)	Material			
	i) Clamp body			
	ii) Bolts and nuts			
	iii) Spring washer			
	iv) Liners if any			
d)	Rated current	(Amp)	2500	
e)	Rated terminal load	(Kg)	100 (Static)	
f)	Weight of clamp complete with	(Kg)		
26	Operating Mechanism			
a)	Type of operating mechanism		Manual	
b)	Name of manufacturer			
c)	Type of manual operating mechanism for isolator pole			
d)	Force required to operate manual operating mechanism	(Kg)		
e)	Whether padlocking included as per the specification	(Yes/No)		
f)	Type of manual device for Earthing			
g)	Force required to operate manual device for earthing switch	(Kg)		
27	Interlocking			
a)	Details of mechanical interlock between isolator and earth switch	(Yes/No)		
28	Size and Weight			
a)	Weight of each pole	(Kg)		
b)	Space requirement i.e. length.	(mm)		
c)	Height of 3 phase isolator without earth switch.	(mm)		
d)	Dimension of the isolators			
	i) without earthing switch	(mm x mm x mm)		
	ii) with earth switch on one side	(mm x mm x		
29	Enclosures			
	Whether the following are enclosed			
	i) Type test report for main equipment and auxiliaries	(Yes/No)		
	ii) Drawings as per specification	(Yes/No)		

Sl. No.	Description	Unit	Specific Requirements	Guaranteed Particulars
			2 Pole	
	iii) Technical literature for isolator, operating mechanism and support insulators.	(Yes/No)		
30	**A. Tandem Pipe**			
	a) Size (internal diameter)	(mm)	25	
	b) Class		B	
	c) Material		GI	
	B. Down pipe			
	a) Internal dia.	(mm)	50	
	b) Class		B	
	c) Material		GI	

Note (N.A.) be written against the item which is not applicable.

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4 36 KV THREE PHASE VCBs/LBS (RMUs)

Sl. No.	Description	Unit	Guaranteed Particulars
I	**Tenderer's Name and address**		
1	Manufacturer's name & address for		
i)	Ring Main Unit		
ii)	Earth Bar Material & Size		
iii)	Current Transformers		
iv)	Voltage Transformers		
v)	Relays		
vi)	Instruments		
vii)	Timers		
viii)	Wires		
ix)	Other accessories		
2	Tenderer's proposal No. & date		
3	Name and address of Tenderer's representative from whom technical clarifications can be obtained		
4	Altitude of Operation		
5	Design Ambient temperature		
6	Guaranteed Delivery Schedule		
II.	**RING MAIN UNIT : GENERAL**		
1	Rated voltage		
2	Maximum service voltage		
3	Rated frequency		
4	One minute power frequency withstand voltage		
5	Impulse withstand voltage		
6	Maximum temperature rise over ambient		
7	Interchangeability of similar equipment		
8	Rated Life of equipment (Years)		
9	Does the container have moisture absorbing material		
10	Overall dimensions for each RMU		
	a) Length		
	b) Height		
	c) Depth		
11	Total weight		
12	Load for foundation design(dead weight plus impact load)	Yes/No	
13	Have the mechanical safety interlocks provided		
	(a) between load break switch & earth switches	Yes/No	
	(b) between breaker & earth switche	Yes/No	
14	Whether fully compartmentalised designs or not		
15	Applicable standard and degree of protection		

Sl. No.	Description	Unit	Guaranteed Particulars
16	Maximum heat dissipation (kW)		
17	Type of sheet steel (hot roled or cold rolled) and sheat steel thickness		
18	Rated voltage and kw rating of space		
19	Whether each RMU is extendable or not	Yes/No	
20	Recommended clearances from the		
	a) Front		
	b) Rear		
	c) Sides		
III	GAS CONTAINER & PRESSURE		
1	standard Applicable		
2 (a)	Material of Gas Container		
(b)	Is it of welded steel	Yes/No	
3	Thickness of gas container		
4	Size of Gas Container (Volume)		
5	Rated SF6 Filling Pressure at 40°C (bar)		
6	Setting of pressure relief valve (bar)		
7	Normal operating gas pressure (bar)		
8	Leakage of gas/year (percent)		
9	Is gas container sealed for the life of RMU		
10	In case of loss of gas pressure, is equipment safe	Yes/No	
IV.	BUS-BARS		
1	Conductor material		
2	Conductor cross-section		
3	Bare/Painted/PVC sleeves/Epoxy encapsulated		
4	Rated short time current and its duration		
5	One minute power frequency withstand voltage		
6	Impulse withstand voltage		
7	Rated continuous current at specified ambient temperature & altitude		
8	Maximum temperature rise over ambient temperature for current rating as per 4 (vii) above		
9	Minimum clearances in gas container		
	a) Between		
	b) Phases to earth		
10	Applicable standard		
11	Calculation establishing adequacy of cross section and supports for short circuit and thermal currents		
12	Bus joints silver plated	Yes/No	
13	Is phase barrier provided	Yes/No	

Sl. No.	Description	Unit	Guaranteed Particulars
14	Material for busbar supports		
15	Voltage class of support		
16	Standard to which busbar supports		

Sl. No.	Description	Unit	Guaranteed Particulars
V	LOAD BREAK SWITCHES IN RMU		
1	System Voltage		
2	Applicable Standard		
3	Rated Voltage		
4	Service Voltage		
5	1 Minute Power Frequency withstand Voltage (kV)		
6	Lightning Impulse withstand voltage		
	a) Phase to Phase		
	b) Phase to earth		
	c) Across isolating distance		
7	Rated Normal Current		
8	Rated short time (3 sec) current withstand (kA)		
9	Rated short circuit making capacity of		
	a) Line switches		
	b) earth switches		
10	Number of operations at rated short circuit		
	a) Line switches		
	b) earth switches		
11	Rated breaking current of line switch		
12	Rated cable charging breaking current of line switch		
13	Rated inductive (magnetising) break current of line switch		
14	Number of mechanical operations (open/close)		
	a) Line switches		
	b) earth switches		
15	Number of Electrical operations at full ring main current		
16	Closing time with motor drive		
17	Opening time with motor drive		
18	Motor watts		
19	Motor rated voltage		
20	Motor rated current		
21	Motor starting current		
22	No. of Aux. Switches		
	a) NO		
	b) NC		
	c) Breaking capacity		

Sl. No.	Description	Unit	Guaranteed Particulars
VI.	VACCUM CIRCUIT BREAKERS IN RING MAIN UNIT		
1	Rated voltage and frequency		
2	Rated short time withstand current and its duration with breaker as housed in the RMU enclosure		
3	Making current (Peak)		
4	One minute power frequency withstand voltage		
5	Impulse withstand voltage		
6	Maximum temperature rise over ambient specified		
7	Number of operations at rated short circuit current		
8	Duty cycle		
9	(a) Number of mechanical operations of Circuit breaker (open/close)		
	(b) Number of operations at rated short circuit current on circuit breaker		
10	Standard applicable		
11	Whether control circuitry suitable for monitoring of closing and tripping circuit		
12	Maximum design voltage		
13	(a) Symmerical breaking capacity (in kA)		
	(b) Asymmeterical breaking capacity (in		
14	(a) Rated continuous current rating for breaker & corresponding temperature		
	(b) Rated continuous current rating for breaker at the specified ambient temperature & altitude		
15	Number of breaks/phase		
17	Type of material of contacts :		
	a) Main		
	b) Arcing		
19	Whether contacts are silver plated and thickness of plating		
20	Whether breaker designed to close and latch on making or fitted with making current release?		
21	Whether trip free or fixed trip mechanically and electrically		
22	Type of closing		
23	Type of tripping		
24	Normal voltage of		
	(a) Closing/tripping mechanism		
	(b) Spring charging motor		
25	Allowable variation of voltage for above		

Sl. No.	Description	Unit	Guaranteed Particulars
26	Power required at normal voltage for		
	a) Trip coil		
	b) Closing coil		

Sl. No.	Description	Unit	Guaranteed Particulars
	c) Spring charging motor		
27	Wheight of circuit breaker		
28	Opening time in cycles		
29	Making time in cycles		
30	Opening time at :		
	a) 10% of rated short circuit current		
	b) 50% of rated short circuit current		
	c) 100% of rated short circuit current		
31	Whether auxillary contacts over and above those required for breaker operation/ annunciation have been provided or not		
32	Current carrying capacity of auxilliary switches		
33	Accessibility of line connection	Front/ rear	
34	Whether terminals suitable for direct connection to transformer	Yes/No	
35	Schematic control diagram of circuit breaker enclosed	Yes/No	
36	Interrupter		
31	(a) Make of interrupter		
	(b) Pressure inside the interrupter	Min Hg.	
	c) Contact wear indication provided	Yes/No	
	(d) Mechanical facility for checking loss of vaccum provided	Yes/No	
	(e) Vaccum monitoring relay provided	Yes/No	
	(f) Adequate shielding against X-Ray rediations provided	Yes/No	
32	Switching over voltages generated by the circuit breakers with and without surge suppressors		
VII.	CONTROL OPERATION		
	As no DC battery has been provided, has the proposed control supply arrangement details been provided with complete drawings, write-up &		
VIII.	CURRENT TRANSFORMERS		
1	Type		
2	Rated voltage and frequency		
3	Rated short time current and its duration		
4	Dynamic current rating (Peak)		
5	One minute power frequency withstand voltage of primary and secondary winding		
6	Impulse withstand voltage		
7	Maximum temperature rise over ambient		

Sl. No.	Description	Unit	Guaranteed Particulars
8	Class of insulation		
9	Standard applicable		
10	Metering CTs		
a)	Ratios in line with single line diagram		
b)	Rated VA burden		
c)	Accuracy class		
d)	Instrument security factor		
11	Protection CTs		
a)	Ratio		
b)	Rated VA burden		
c)	Accuracy class and accuracy limit factor		
IX.	VOLTAGE TRANSFORMER ON BUS BAR		
1	Type		
2	Rated transformation ratio		
3	Rated frequency		
4	One minute power frequency withstand voltage		
5	Impulse withstand voltage		
6	Maximum temperature rise over ambient		
7	Interchangeability of similar equipment		
8	Standard applicable		
9	Class of insulation		
10	Number of secondary winding		
11	Winding Connections		
12	Rated secondary voltage		
13	Rating for dual purpose of protection and measurement		
14	Rated output of each secondary winding		
15	Accuracy class of each secondary winding		
16	No. of auxiliary drawout contacts on VT		
17	Rated voltage factor		
	a) Continuous		
	b) 8 hours		
18	Temperature rise for rated output		
19	Rating of HV side fuse		
20	Characteristics of HV side fuse & LV side MCB furnished?		
X	OVER CURRENT & EARTH FAULT RELAYS		
1	Type		
2	a) Rated current/voltage		

Sl. No.	Description	Unit	Guaranteed Particulars
	b) Current/voltage settings range in percentage of rated current voltage at taps provided		
	c) Continuous rating		
	d) Error on different setting		
	e) Sensitivity		

Sl. No.	Description	Unit	Guaranteed Particulars
3	Resetting ratio		
4	Rated short-time thermal current/voltage for 1 sec. at different taps		
5	One minute power frequency withstand test voltage		
6	a) No. of type of contacts (normally closed or normally open)		
	b) Rating of contacts		
7	Operating time at ten times setting		
8	Time setting sof inverse or definite time current relays		
9	Current time characteristics for inverse or definite time current voltage relays		
10	Resetting time		
11	Rated burden at lowest and highest settings		
12	Details of series or shunt seal in units if provided		
13	Hand reset flag indication provided or not		
14	Detailed literature furnished with reference		
15	Details of testng facilities		
16	For micro processor based relays		
a)	Make & Type		
b)	Current Rating		
c)	Voltage Rating		
d)	Number of relay elements provided		
e)	Detailed literature enclosed		
XI.	AUXILIARY RELAYS		
1	Type		
2	Rated current/voltage and permissible variation		
3	Rated burden		
4	No. and type of contacts (whether 'NO' or 'NC')		
5	Rating of contacts		
6	Total operating time of relays		
7	One minute power frequency withstand voltage	Yes/No	
8	Detailed literature furnished with the bid	Yes/No	
9	Details of testing facilities provided		
XII	INDICATING LAMP		
1	Make		
2	Type		
3	Rated voltage		

Sl. No.	Description	Unit	Guaranteed Particulars
4	Rated power consumption(watts)		
5	Series resister provided	Yes/No	

Sl. No.	Description	Unit	Guaranteed Particulars
XIII.	INDICATING METERS		
a)	Ammeter		
1	Make		
2	Type of movement		
3	Size (square mm)		
4	Scale size in degree		
5	Accuracy		
6	Range offered in line with specification		
7	VA burden		
8	Applicable standard		
b)	Voltmeter		
1	Make		
2	Type of movement	Yes/No	
3	Size (square mm)		
4	Scale size in degree		
5	Accuracy		
6	Range offered in line with specification		
7	VA burden		
8	Applicable standard		
XIV.	ENERGY METER		
1	Make		
2	Type		
3	Range		
4	Detailed literature furnished	Yes/No	
5	Standard to which it conform to		
6	Rated current		
7	Rated voltage and frequency		
8	Drawout/non-drawout		
9	Rated VA burden		
a)	Current coil	VA	
b)	Voltage coil	VA	
10	Test plug/test blocks/testing terminals with links		
XV.	CONTROL CIRCUIT		
1	Protective Relays		
2	Micro Processor based Protective Relays		
3	-3 O/C Relay setting range		
4	-1 E/F Relay setting range		
5	Indications		
8	Relay characteristics		

Sl. No.	Description	Unit	Guaranteed Particulars
XVI.	CABLE BOXES		
1	Are these air insulated	Yes/No	
2	Termination arrangement		
3	Distance from the gland plate to the termination point (mm)		
4	Permitted test voltage in kV for (ten minute) for cable checking		
XVII.	VOLTAGE INDICATORS & PHASE COMPARATORS		
1	Detailed specifications for capactive indicators		
2	Details of arrangement to indicate voltage on cables		
3	Voltage of capacitive voltage divider for indication purpose (volt)		
XVIII.	FAULT CURRENT INDICATOR		
1	Make		
2	Type		
3	Is External Power Suply required	Yes/No	
4	Internal Power Supply (Rechargeable battery)		
5	Trip current to Earth Fault		
6	Trip current to short circuit		
7	Response Delay (ms)		
8	Temperature Range		
9	External Indication		
10	Weight of Unit (kg)		
XIX.	MINIATURE CIRCUIT BREAKERS		
1	Make		
2	Rated voltage		
3	Rated Current		
4	Rupturing capacity		
5	Setting for Short circuit		
6	Setting range for overload		
7	Operating time		
8	Number of auxiliary contacts		
9	Rating for auxiliary contacts		
10	Operating characteristics furnished	Yes/No	

Sl. No.	Description	Unit	Guaranteed Particulars
XX.	CONTROL WIRING		
1	Material and size of conductor		
a)	For CT circuit		
b)	For other circuit		
2	Number of strands in conductor		
3	Tinned/untinned		
4	Material of insulation and sheath		
5	Voltage grade of control wiring		
6	Colour coding of wires		
a)	For AC metering circuit		
b)	for DC control circuit		
c)	AC auxiliary power circuit like panel space heater		
d)	Earthing		
7	Numbered ferrules at both ends	Yes/No	
8	Insulator sleeves provided at both ends	Yes/No	
9	Terminals		
a)	Make		
b)	Current rating		
c)	Clamp type or bolt type		
d)	Maximum conductor size and number of conductor which it can receive		
e)	Disconnecting type of Ct circuit		
f)	Terminal making facility provided		
g)	Crimp type connectors provided at the terminals		
h)	Spare terminals		

Signature :

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5 AC DISTRIBUTION BOARD

Sl. No.	Description	Unit	Guaranteed Particulars
I.	GENERAL		
1	Rated Voltage	(Volts)	
2	Symmetrical short circuit withstand current of switchgear cubicle	(kA)	
3	Degree of protection as per IS: 13947		
a)	Breaker / AC distribution cubicles.		
b)	Bus bar chamber.		
4	Cubicle sheet metal thickness for front, rear, sides and top.	(mm)	
5	Painting shade as per IS:5		
a)	External surface		
b)	Internal surface		
6	Standard height, width & depth of typical panel.		
a)	Air circuit breaker panel	(mm)	
b)	Switch fuse cubicle.	(mm)	
c)	AC Distribution Board.	(mm)	
7	Width of cable alley	(mm)	
8	Earth bus bar size and material.	(mm x mm)	
9	Recommended dynamic loading for foundation design.	(N)	
10	Approximate weight of AC Distribution Board.	(Kg)	
11	Is extension possible in future.	(Yes/No)	
12	Clearance in air		
a)	Between phases	(mm)	
b)	Between phase and earth	(mm)	
II.	CURRENT TRANSFORMERS		
1	Manufacturer's Name		
2	Applicable standard		
3	Ratio		
4	Rated output		
5	Accuracy class		
6	Instrument Security Factor (ISF).		
7	Insulation level	(kV rms)	
8	Nominal rated voltage	(kV)	
9	Short time thermal rating for 1 sec.	(kA rms)	
10	Class of insulation.		

Sl. No.	Description	Unit	Guaranteed Particulars
III.	POTENTIAL TRANSFORMERS		
1	Manufacturer's Name		
2	Applicable standard		
3	Rated primary voltage	(Volts)	
4	Rated Secondary voltage	(Volts)	
5	Accuracy class		
6	Insulation level	(kV rms)	
7	Rated Burden	(VA)	
8	Over voltage factor		
9	Class of insulation		
IV.	AIR CIRCUIT BREAKER/ MOULDED CASE CIRCUIT BREAKER		
1	Name of manufacturer and country		
2	Manufacturer's type designation		
3	Applicable standard		
4	Rated voltage	(kV)	
5	Rated current at design ambient temperature	(Amps)	
6	Continuous current at site ambient temperature.	(Amps)	
7	Rated symmetrical breaking current	(kA)	
8	Rated making current	(kA)	
9	Short time current rating	(kA, sec)	
10	Short circuit performance category		
11	Temperature rise of main contacts when carrying continuous current	(Deg. C)	
12	Thickness of silver coating for main contacts	(microns)	
13	Number of operations circuit breaker can make without inspection replacement of contacts or other parts at 100% rated breaking current.		
14	a) Number of auxiliary contacts provided and their rating.	(Amps)	
	b) Total operating time	(ms)	
	c) Whether trip free or fixed trip type		
15	Operating mechanism		
a)	Motor rating	(V, A, Watts)	
b)	Time for fully charging the closing spring	(Sec)	
c)	Emergency manual charging facility provided	(Yes/No)	

Sl. No.	Description	Unit	Guaranteed Particulars
d)	Limits of voltage for satisfactory operation of following devices, as percentage of normal voltage.		
	i) Motor	(%)	
	ii) Closing Coil	(%)	
	iii) Tripping Coil	(%)	

Sl. No.	Description	Unit	Guaranteed Particulars
16	Air break switches		
a)	Type, make		
b)	Rated voltage	(Volts)	
c)	Rated current	(Amps)	
d)	Type and material of contacts		
e)	Applicable standard		
f)	Maximum through fault current withstand	(kA)	
g)	Door inter locks provided	(Yes/No)	
h)	Rated making and breaking capacity	(kA)	
17	Fuses		
a)	Make		
b)	Type		
c)	Rupturing capacity	(kA)	
d)	Peak cut-off current	(kA)	
e)	Whether mounted on insulated carrier	(Yes/ No)	
18	Rated operating Duty		
V.	**BUS BARS AND INSULATORS**		
1	Material and applicable standard		
2	Bare/Painted/Epoxy insulated/Sleeved		
3	Minimum clearance		
a)	Phase to phase	(mm)	
b)	Phase to earth	(mm)	
4	Continuous current rating at ambient temperature	(Deg. C)	
5	Minimum Cross section provided for		
a)	Horizontal bus bar	(sq. mm)	
b)	Vertical bus bar	(sq. mm)	
6	Short time current rating for 1 sec.	(kArms)	
7	Material of the support insulators.		
8	Temperature rise over ambient temperature for continuous current rating	(Deg. C)	
9	Whether bus joints are silver faced	(Yes / No)	
10	Dynamic current withstand rating	(kApeak)	

Sl. No.	Description	Unit	Guaranteed Particulars
VI.	**CONTACTORS**		
1	Make		
2	Type and applicable standard		
3	No. of poles	(Nos.)	
4	Rated voltage of main and auxiliary contacts.	(Volts)	
5	Limits of operation		
a)	Supply voltage variation	(+/-%)	
b)	Supply frequency variation for closing.	(+/-%)	
c)	Drop out voltage	(Volts)	
6	Rated breaking capacity	(kA)	
7	Rated making capacity	(kA)	
8	Rated thermal current	(kA)	
9	Maximum recommended back up HRC fuse size.	(Amp)	
10	Rated operating duty		
11	Rated voltage of coils	(Volts)	
VII.	**AUXILIARY CONTACTOR**		
1	Make		
2	Type		
3	Coil voltage	(Volts)	
4	Coil burden	(VA)	
5	No. of contacts and their rating	(VA, AC)	
VIII.	**CONTROL / SELECTOR SWITCH**		
1	Make		
2	Type		
3	Type of handle		
4	Number of contacts	(Nos.)	
5	Rating of contacts	(V, A, AC/DC)	
6	No. of positions	(Nos.)	
7	Contact material and plating		
IX.	**PUSH BUTTONS**		
1	Make		
2	Contact type		
3	Number of contacts (NO+ NC)	(Nos.)	
4	Contact rating	(V, A, AC/DC)	
X.	**SPACE HEATERS**		
1	Make		
2	Type		
3	Rated Voltage	(Volts)	
4	Thermostat setting range	(Deg. C)	
5	Heater output	(Watts)	

Sl. No.	Description	Unit	Guaranteed Particulars
XI.	WIRING AND TERMINAL BLOCKS		
1	Voltage grade of wires	(Volts)	
2	Minimum size of conductor for		
a)	Power wiring	(sq. mm)	
b)	Control wiring	(sq. mm)	
3	Type of control terminal block on		
a)	Fixed portion and draw out portion		
b)	Switchgear and breaker		
4	Make and type of terminal blocks		
5	Current rating of terminal blocks	(Amp)	
6	Insulation of wires		
7	Conductor material		
XII.	RELAYS		
1	Make		
2	Type		
3	Application		
4	Operating principle		
5	Coil burden	(VA)	
6	Setting range	(%)	
7	Number of contacts	(Nos.)	
8	Contact rating	(V, A, AC/DC)	
9	Contacts - (self reset or hand reset)		
10	Operation indicator provided	(Yes/No)	
11	Time of operation	(ms)	
XIII.	INDICATING LAMPS		
1	Make		
2	Type		
3	Voltage	(Volts)	
4	Series resistor value and rating	(Ohms, Amp)	
XIV.	INDICATING INSTRUMENTS		
1	Voltmeter		
a)	Make		
b)	Type		
c)	Accuracy class		
d)	Voltage coil rating	(Volts)	
e)	Voltage coil burden	(VA)	
f)	Case size	(mm x mm)	

Sl. No.	Description	Unit	Guaranteed Particulars
g)	Angle of defelection	(Degrees)	
h)	Scale length		
2	Ammeter		
a)	Make		
b)	Type		
c)	Accuracy class		
d)	Current coil rating	(Amp)	
e)	Current coil burden	(VA)	
f)	Case size	(mm x mm)	
g)	Angle of defelection	(Degrees)	
h)	Scale length		
XV.	**ENCLOSURES**		
1	Whether all the drawings as indicated in the specification enclosed.	(Yes/No)	
2	Whether all type test reports enclosed	(Yes/No)	
3	Whether characteristics of various types of relays for MCCB enclosed.	(Yes/No)	
4	Whether calculations furnished in support of adequacy of bus bar size (AC bus/DC bus) for specified current rating.	(Yes/No)	
XVI.	**Miniature circuit breaker**		
1	Manufacturer's name and country of manufacture.		
2	Type		
3	Rated voltage	(Volts)	
4	No. of poles	(Nos.)	
5	Frequency	(Hz)	
6	Current rating	(Amp)	
	a) Continuous at 50 Deg. C ambient temperature	(Amp)	
	b) 1 sec.	(kA rms)	
7	Breaking capacity for Single Phase / Double Pole / Triple Pole		
	a) Symmetrical (kA rms at volt)		
	b) Asymmetrical(kA rms at volt)		

Sl. No.	Description	Unit	Guaranteed Particulars
8	Total interrupting time	(Cycle)	
9	Type of blow out device		
10	Type of overload (terminal/magnetic)		
11	Terminal suitable for cable size	(sq. mm)	
12	Upto what fault current discrimination between incomer fuse & MCB will be obtained?	(kA)	
13	Standards to which Miniature Circuit Breaker conforms		

Note: (N.A.) be written against the item which is not

Signature:

Seal:

5 AC DISTRIBUTION BOARD

Sl. No.	Description	Unit	Guaranteed Particulars
I.	GENERAL		
1	Rated Voltage	(Volts)	
2	Symmetrical short circuit withstand current of switchgear cubicle	(kA)	
3	Degree of protection as per IS: 13947		
a)	Breaker / AC distribution cubicles.		
b)	Bus bar chamber.		
4	Cubicle sheet metal thickness for front, rear, sides and top.	(mm)	
5	Painting shade as per IS:5		
a)	External surface		
b)	Internal surface		
6	Standard height, width & depth of typical panel.		
a)	Air circuit breaker panel	(mm)	
b)	Switch fuse cubicle.	(mm)	
c)	AC Distribution Board.	(mm)	
7	Width of cable alley	(mm)	
8	Earth bus bar size and material.	(mm x mm)	
9	Recommended dynamic loading for foundation design.	(N)	
10	Approximate weight of AC Distribution Board.	(Kg)	
11	Is extension possible in future.	(Yes/No)	
12	Clearance in air		
a)	Between phases	(mm)	
b)	Between phase and earth	(mm)	
II.	CURRENT TRANSFORMERS		
1	Manufacturer's Name		
2	Applicable standard		
3	Ratio		
4	Rated output		
5	Accuracy class		
6	Instrument Security Factor (ISF).		
7	Insulation level	(kV rms)	
8	Nominal rated voltage	(kV)	
9	Short time thermal rating for 1 sec.	(kA rms)	
10	Class of insulation.		

Sl. No.	Description	Unit	Guaranteed Particulars
III.	POTENTIAL TRANSFORMERS		
1	Manufacturer's Name		
2	Applicable standard		
3	Rated primary voltage	(Volts)	
4	Rated Secondary voltage	(Volts)	
5	Accuracy class		
6	Insulation level	(kV rms)	
7	Rated Burden	(VA)	
8	Over voltage factor		
9	Class of insulation		
IV.	AIR CIRCUIT BREAKER/ MOULDED CASE CIRCUIT BREAKER		
1	Name of manufacturer and country		
2	Manufacturer's type designation		
3	Applicable standard		
4	Rated voltage	(kV)	
5	Rated current at design ambient temperature	(Amps)	
6	Continuous current at site ambient temperature.	(Amps)	
7	Rated symmetrical breaking current	(kA)	
8	Rated making current	(kA)	
9	Short time current rating	(kA, sec)	
10	Short circuit performance category		
11	Temperature rise of main contacts when carrying continuous current	(Deg. C)	
12	Thickness of silver coating for main contacts	(microns)	
13	Number of operations circuit breaker can make without inspection replacement of contacts or other parts at 100% rated breaking current.		
14	a) Number of auxiliary contacts provided and their rating.	(Amps)	
	b) Total operating time	(ms)	
	c) Whether trip free or fixed trip type		
15	Operating mechanism		
a)	Motor rating	(V, A, Watts)	
b)	Time for fully charging the closing spring	(Sec)	
c)	Emergency manual charging facility provided	(Yes/No)	

Sl. No.	Description	Unit	Guaranteed Particulars
d)	Limits of voltage for satisfactory operation of following devices, as percentage of normal voltage.		
	i) Motor	(%)	
	ii) Closing Coil	(%)	
	iii) Tripping Coil	(%)	

Sl. No.	Description	Unit	Guaranteed Particulars
16	Air break switches		
a)	Type, make		
b)	Rated voltage	(Volts)	
c)	Rated current	(Amps)	
d)	Type and material of contacts		
e)	Applicable standard		
f)	Maximum through fault current withstand	(kA)	
g)	Door inter locks provided	(Yes/No)	
h)	Rated making and breaking capacity	(kA)	
17	Fuses		
a)	Make		
b)	Type		
c)	Rupturing capacity	(kA)	
d)	Peak cut-off current	(kA)	
e)	Whether mounted on insulated carrier	(Yes/ No)	
18	Rated operating Duty		
V.	**BUS BARS AND INSULATORS**		
1	Material and applicable standard		
2	Bare/Painted/Epoxy insulated/Sleeved		
3	Minimum clearance		
a)	Phase to phase	(mm)	
b)	Phase to earth	(mm)	
4	Continuous current rating at ambient temperature	(Deg. C)	
5	Minimum Cross section provided for		
a)	Horizontal bus bar	(sq. mm)	
b)	Vertical bus bar	(sq. mm)	
6	Short time current rating for 1 sec.	(kArms)	
7	Material of the support insulators.		
8	Temperature rise over ambient temperature for continuous current rating	(Deg. C)	
9	Whether bus joints are silver faced	(Yes / No)	
10	Dynamic current withstand rating	(kApeak)	

Sl. No.	Description	Unit	Guaranteed Particulars
VI.	**CONTACTORS**		
1	Make		
2	Type and applicable standard		
3	No. of poles	(Nos.)	
4	Rated voltage of main and auxiliary contacts.	(Volts)	
5	Limits of operation		
a)	Supply voltage variation	(+/-%)	
b)	Supply frequency variation for closing.	(+/-%)	
c)	Drop out voltage	(Volts)	
6	Rated breaking capacity	(kA)	
7	Rated making capacity	(kA)	
8	Rated thermal current	(kA)	
9	Maximum recommended back up HRC fuse size.	(Amp)	
10	Rated operating duty		
11	Rated voltage of coils	(Volts)	
VII.	**AUXILIARY CONTACTOR**		
1	Make		
2	Type		
3	Coil voltage	(Volts)	
4	Coil burden	(VA)	
5	No. of contacts and their rating	(VA, AC)	
VIII.	**CONTROL / SELECTOR SWITCH**		
1	Make		
2	Type		
3	Type of handle		
4	Number of contacts	(Nos.)	
5	Rating of contacts	(V, A, AC/DC)	
6	No. of positions	(Nos.)	
7	Contact material and plating		
IX.	**PUSH BUTTONS**		
1	Make		
2	Contact type		
3	Number of contacts (NO+ NC)	(Nos.)	
4	Contact rating	(V, A, AC/DC)	
X.	**SPACE HEATERS**		
1	Make		
2	Type		
3	Rated Voltage	(Volts)	
4	Thermostat setting range	(Deg. C)	
5	Heater output	(Watts)	

Sl. No.	Description	Unit	Guaranteed Particulars
XI.	WIRING AND TERMINAL BLOCKS		
1	Voltage grade of wires	(Volts)	
2	Minimum size of conductor for		
a)	Power wiring	(sq. mm)	
b)	Control wiring	(sq. mm)	
3	Type of control terminal block on		
a)	Fixed portion and draw out portion		
b)	Switchgear and breaker		
4	Make and type of terminal blocks		
5	Current rating of terminal blocks	(Amp)	
6	Insulation of wires		
7	Conductor material		
XII.	RELAYS		
1	Make		
2	Type		
3	Application		
4	Operating principle		
5	Coil burden	(VA)	
6	Setting range	(%)	
7	Number of contacts	(Nos.)	
8	Contact rating	(V, A, AC/DC)	
9	Contacts - (self reset or hand reset)		
10	Operation indicator provided	(Yes/No)	
11	Time of operation	(ms)	
XIII.	INDICATING LAMPS		
1	Make		
2	Type		
3	Voltage	(Volts)	
4	Series resistor value and rating	(Ohms, Amp)	
XIV.	INDICATING INSTRUMENTS		
1	Voltmeter		
a)	Make		
b)	Type		
c)	Accuracy class		
d)	Voltage coil rating	(Volts)	
e)	Voltage coil burden	(VA)	
f)	Case size	(mm x mm)	

Sl. No.	Description	Unit	Guaranteed Particulars
g)	Angle of defelection	(Degrees)	
h)	Scale length		
2	Ammeter		
a)	Make		
b)	Type		
c)	Accuracy class		
d)	Current coil rating	(Amp)	
e)	Current coil burden	(VA)	
f)	Case size	(mm x mm)	
g)	Angle of defelection	(Degrees)	
h)	Scale length		
XV.	**ENCLOSURES**		
1	Whether all the drawings as indicated in the specification enclosed.	(Yes/No)	
2	Whether all type test reports enclosed	(Yes/No)	
3	Whether characteristics of various types of relays for MCCB enclosed.	(Yes/No)	
4	Whether calculations furnished in support of adequacy of bus bar size (AC bus/DC bus) for specified current rating.	(Yes/No)	
XVI.	**Miniature circuit breaker**		
1	Manufacturer's name and country of manufacture.		
2	Type		
3	Rated voltage	(Volts)	
4	No. of poles	(Nos.)	
5	Frequency	(Hz)	
6	Current rating	(Amp)	
	a) Continuous at 50 Deg. C ambient temperature	(Amp)	
	b) 1 sec.	(kA rms)	
7	Breaking capacity for Single Phase / Double Pole / Triple Pole		
	a) Symmetrical (kA rms at volt)		
	b) Asymmetrical(kA rms at volt)		

Sl. No.	Description	Unit	Guaranteed Particulars
8	Total interrupting time	(Cycle)	
9	Type of blow out device		
10	Type of overload (terminal/magnetic)		
11	Terminal suitable for cable size	(sq. mm)	
12	Upto what fault current discrimination between incomer fuse & MCB will be obtained?	(kA)	
13	Standards to which Miniature Circuit Breaker conforms		

Note: (N.A.) be written against the item which is not

Signature:

Seal:

6 LT FEEDER & STEEL LIGHT PILLARS

Sl. No.	Description	Unit	Guaranteed Particulars
I.	GENERAL		
1	Rated Voltage	(Volts)	
2	Symmetrical short circuit withstand current of switchgear cubicle	(kA)	
3	Degree of protection as per IS: 13947		
4	Cubicle sheet metal thickness for front, rear, sides and top.	(mm)	
5	Painting shade as per IS:5		
a)	External surface		
b)	Internal surface		
6	Standard height, width & depth of typical panel.		
a)	Feeder pillar	(mm)	
b)	Street light pillar	(mm)	
c)	AC Distribution Board.	(mm)	
7	Width of cable alley	(mm)	
8	Earth bus bar size and material.	(mm x mm)	
9	Recommended dynamic loading for foundation design.	(N)	
10	Approximate weight of pillar	(Kg)	
a)	Feeder Pillar		
b)	Street light pillar		
11	Is extension possible in future.	(Yes/No)	
12	Clearance in air		
a)	Between phases	(mm)	
b)	Between phase and earth	(mm)	
II.	CURRENT TRANSFORMERS		
1	Manufacturer's Name		
2	Applicable standard		
3	Ratio		
4	Rated output		
5	Accuracy class		
6	Instrument Security Factor (ISF).		
7	Insulation level	(kV rms)	

Sl. No.	Description	Unit	Guaranteed Particulars
8	Nominal rated voltage	(kV)	
9	Short time thermal rating for 1 sec.	(kA *rms*)	
10	Class of insulation.		
III.	POTENTIAL TRANSFORMERS		
1	Manufacturer's Name		
2	Applicable standard		
3	Rated primary voltage	(Volts)	
4	Rated Secondary voltage	(Volts)	
5	Accuracy class		
6	Insulation level	(kV rms)	
7	Rated Burden	(VA)	
8	Over voltage factor		
9	Class of insulation		
IV.	MOULDED CASE CIRCUIT BREAKER		
1	Name of manufacturer and country		
2	Manufacturer's type designation		
3	Applicable standard		
4	Rated voltage	(kV)	
5	Rated current at design ambient temperature	(Amps)	
6	Continuous current at site ambient temperature.	(Amps)	
7	Rated symmetrical breaking current	(kA)	
8	Rated making current	(kA)	
9	Short time current rating	(kA, sec)	
10	Short circuit performance category		
11	Temperature rise of main contacts when carrying continuous current	(Deg. C)	
12	Thickness of silver coating for main contacts	(microns)	
13	Number of operations circuit breaker can make without inspection replacement of contacts or other parts at 100% rated breaking current.		
14	a) Number of auxiliary contacts provided and their rating.	(Amps)	
	b) Total operating time	(ms)	

Sl. No.	Description	Unit	Guaranteed Particulars
	c) Whether trip free or fixed trip type		

Sl. No.	Description	Unit	Guaranteed Particulars
15	Air break switches		
a)	Type, make		
b)	Rated voltage	(Volts)	
c)	Rated current	(Amps)	
d)	Type and material of contacts		
e)	Applicable standard		
f)	Maximum through fault current withstand	(kA)	
g)	Door inter locks provided	(Yes/No)	
h)	Rated making and breaking capacity	(kA)	
16	Fuses		
a)	Make		
b)	Type		
c)	Rupturing capacity	(kA)	
d)	Peak cut-off current	(kA)	
e)	Whether mounted on insulated carrier	(Yes/ No)	
17	Rated operating Duty		
V.	BUS BARS AND INSULATORS		
1	Material and applicable standard		
2	Bare/Painted/Epoxy insulated/Sleeved		
3	Minimum clearance		
a)	Phase to phase	(mm)	
b)	Phase to earth	(mm)	
4	Continuous current rating at ambient temperature	(Deg. C)	
5	Minimum Cross section provided for		
a)	Horizontal bus bar	(sq. mm)	
b)	Vertical bus bar	(sq. mm)	
6	Short time current rating for 1 sec.	(kArms)	
7	Material of the support insulators.		
8	Temperature rise over ambient temperature for continuous current rating	(Deg. C)	
9	Whether bus joints are silver faced	(Yes / No)	
10	Dynamic current withstand rating	(kApeak)	

Sl. No.	Description	Unit	Guaranteed Particulars
VI.	CONTROL / SELECTOR SWITCH		
1	Make		
2	Type		
3	Type of handle		
4	Number of contacts	(Nos.)	
5	Rating of contacts	(V, A, AC/DC)	
6	No. of positions	(Nos.)	
7	Contact material and plating		
VII.	SPACE HEATERS		
1	Make		
2	Type		
3	Rated Voltage	(Volts)	
4	Thermostat setting range	(Deg. C)	
5	Heater output	(Watts)	
VIII.	WIRING AND TERMINAL BLOCKS		
1	Voltage grade of wires	(Volts)	
2	Minimum size of conductor for		
a)	Power wiring	(sq. mm)	
b)	Control wiring	(sq. mm)	
3	Type of control terminal block on		
a)	Fixed portion and draw out portion		
b)	Switchgear and breaker		
4	Make and type of terminal blocks		
5	Current rating of terminal blocks	(Amp)	
6	Insulation of wires		
7	Conductor material		
XIII.	INDICATING LAMPS		
1	Make		
2	Type		
3	Voltage	(Volts)	
4	Series resistor value and rating	(Ohms,	

Sl. No.	Description	Unit	Guaranteed Particulars
IX.	INDICATING INSTRUMENTS		
1	Voltmeter		
a)	Make		
b)	Type		
c)	Accuracy class		
d)	Voltage coil rating	(Volts)	
e)	Voltage coil burden	(VA)	
f)	Case size	(mm x mm)	
g)	Angle of defelection	(Degrees)	
h)	Scale length		
2	Ammeter		
a)	Make		
b)	Type		
c)	Accuracy class		
d)	Current coil rating	(Amp)	
e)	Current coil burden	(VA)	
f)	Case size	(mm x mm)	
g)	Angle of defelection	(Degrees)	
h)	Scale length		
X.	ENCLOSURES		
1	Whether all the drawings as indicated in the specification enclosed.	(Yes/No)	
2	Whether all type test reports enclosed	(Yes/No)	
3	Whether characteristics of various types of relays for MCCB enclosed.	(Yes/No)	
4	Whether calculations furnished in support of adequacy of bus bar size (AC bus/DC bus) for specified current rating.	(Yes/No)	
XI.	MINIATURE CIRCUIT BREAKER		
1	Manufacturer's name and country of manufacture.		
2	Type		
3	Rated voltage	(Volts)	
4	No. of poles	(Nos.)	
5	Frequency	(Hz)	

Sl. No.	Description	Unit	Guaranteed Particulars
6	Current rating	(Amp)	
	a) Continuous at 50 Deg. C ambient temperature	(Amp)	
	b) 1 sec.	(kA rms)	
7	Breaking capacity for Single Phase / Double Pole / Triple Pole		
	a) Symmetrical (kA rms at volt)		
	b) Asymmetrical(kA rms at volt)		
8	Total interrupting time	(Cycle)	
9	Type of blow out device		
10	Type of overload (terminal/magnetic)		
11	Terminal suitable for cable size	(sq. mm)	
12	Upto what fault current discrimination between incomer fuse & MCB will be obtained?	(kA)	
13	Standards to which Miniature Circuit Breaker conforms		

Note: (N.A.) be written against the item which is not

Signature:

Seal:

GUARANTEED TECHNICAL PARTICULARS OF

HT AND LT POWER CABLES

7

Sl. No.	Description	Unit	
1	Name of the manufacturer and country.		
2	Applicable standard		
3	Cable type designation		
4	Voltage rating	(Volts)	
5	Conductor		
a)	Material of conductor and flexibility class as per IS:8130		
b)	Size of conductor	(sq. mm)	
c)	Is conductor stranded	(Yes/No)	
d)	Stranded conductor		
	i) Number of strands in each core		
	ii) Size of strand	(sq. mm)	
	iii) Shape of the stranded conductor		
	iv) Maximum DC resistance at 20 deg C	(Ohms)/ Km)	
6	Number of cores		
7	Insulation		
a)	Insulation material and type designation		
b)	Minimum thickness of insulation	(mm)	
c)	Tolerance on the measured value of thickness	(%)	
d)	Minimum volume resistivity at 27 deg. C, 70 deg. C and 90 deg. C	(Ohm-cm)	
8	Sheath		
a)	Material for inner sheath, type of sheathing (extruded or wrapped) and type designation as per IS:5831.		
b)	Material for outer sheath, type of sheathing (extruded or wrapped) and type designation as per IS:5831.		
c)	Thickness of inner sheath and tolerance on measured value.	(mm, %)	
d)	Thickness of outer sheath and tolerance on measured values.	(mm, %)	
9	Armour		
a)	Material		
b)	Shape		
c)	Dimension	(mm)	
10	a) Overall diameter of cable	(mm)	
	b) Tolerance on diameter	(%)	
11	a) Minimum tensile strength of insulation	(kg/sq. cm)	
	b) Minimum elongation at break.	(%)	
12	a) Minimum tensile strength of sheath.	(kg/sq. cm)	
	b) Minimum elongation at break	(%)	
13	a) Tensile strength of the armour	(kg/sq. cm)	
	b) Elongation after break	(%)	
14	High voltage test and duration (PVC cables)		
a)	At room temperature	(kV, mins.)	
b)	Under water	(kV, mins.)	
15	XLPE cable		

a)	High voltage test	(kV, mins.)	
b)	Short circuit current rating for 1 sec.	(kA)	
c)	Short circuit current rating for armour	(kA, Secs)	
16	a) Current carrying capacity in air and corresponding assumptions/conditions of installation	(Amp)	
	b) Current carrying capacity under following conditions:		
	i) Ambient temperature of 50 Deg. C	(Amp)	
	ii) Cable laid in covered cable trenches	(Amp)	
	iii) 3 to 4 cable trays / racks in trench .	(Amp)	
	iv) 5 to 6 cables per tray and touching each other.	(Amp)	
17	Insulation resistance at 27 Deg. C	(Ohm/km)	
18	Capacitive reactance per Km.	(Ohm/km)	
19	Inductive reactance per Km.	(Ohm/km)	
20	Minimum bending radius.	(mm)	
21	Short circuit current rating for 1 sec. for PVC cable.	(kA)	
22	Conductor temperature rise during		
a)	Normal operation	(Deg. C)	
b)	Short circuit	(Deg. C)	
23	Weight of cable per Km	(Kg/km)\	
24	a) Standard length of cable per drum	(m)	
	b) Tolerance on length of cable per drum	(%)	
25	Net weight of drum length of cable	(Kg)	
26	Method of core identification for		
a)	Cable upto five cores		
b)	Cable with more than five cores		
27	Please indicate writing YES or NO whether the following tests have been carried out.		
	i) Ageing test	(Yes/No)	
	ii) Loss of mass test	(Yes/No)	
	iii) Cold bend test	(Yes/No)	
	iv) Cold impact test	(Yes/No)	
	v) Heat shock test	(Yes/No)	
	vi) Thermal stability as per IEC-540	(Yes/No)	
	vii) Oxygen index test and temperature index test as per ASTM D-2863.	(Yes/No)	
	viii) Rodent and termite proof test	(Yes/No)	
	ix) Fire retardant test	(Yes/No)	
28	Enclosures		
a)	Whether all type test reports enclosed	(Yes/No)	
b)	Whether technical literature enclosed	(Yes/No)	
c)	Whether tables giving rating factors for variation in standard conditions of installation enclosed	(Yes/No)	
d)	Whether relevant drawings enclosed	(Yes/No)	

Note: (N.A.) be written against the item which is not applicable.

Sl. No.	Description	Unit	Guaranteed Particulars
I.	Poles		
a)	Name and address of supplier		
b)	Name and address of manufacturer		
c)	Designation as per IS: 2713		
d)	Overall length (mm)		
e)	Planting depth (mm)		
f)	Height above ground (mm)		
g)	Length of section		
	Bottom (h_3) (m)		
	Middle (h2) (m)		
	Top (h1) (m)		
h)	Outside diameter and thickness of section		
	Bottom (mm)		
	Middle (mm)		
	Top (mm)		
i)	Material & standard to which conforming		
j)	Ultimate, Tensile strength (kg/mm2)		
k)	Nominal weight of Pole (kg)		
l)	Breaking load (kg)		
m)	Couping load (kgf)		
n)	Load for permanent set not exceeding 13 mm (kgf)		
o)	Load for temporary defection of 157.5 mm (kgf)		
p)	Provision of bolts at each swagged portion made and nos., diameter & length of bolts		
q)	Whether hole in bottom section provided for connecting earthing lead, dia. Of hole and height above planting depth.		
r)	Material and dimension of base plates		
s)	Details of painting		
t)	Tolerances		

	- Thickness		
	- Length		
	- Weight		
	- Straightness		
u)	Details of Taper Plug		
II.	**Lighting fixtures & Accessories**		
1	Manufacturer's name		
a)	Fixtures		
b)	Accessories		
2	Country of manufacturer for		
a)	Fixtures		
b)	Accessories		
3	Applicable standards for		
a)	Fixtures		
b)	Accessories		
4	Manufacturer's type and catalogue no. for		
a)	Fixtures		
b)	Accessories		
5	Nominal working voltage	(Volts)	
6	Maximum permissible supply voltage variation for satisfactory operation of		
a)	Fixtures	(+ %)	
b)	Accessories	(+ %)	
7	Power factor at nominal working voltage and frequency		
8	Full load output current at nominal working voltage	(Amps)	
9	Power loss per ballast at nominal working voltage & frequency	(Watts)	
10	Maximum hot spot temperatures of ballast case	(Deg. C)	
11	Maximum average ballast winding temperature	(Deg. C)	
12	Ambient temperature within the fitting in continuous operation at the design ambient air temperature	(Deg. C)	
13	Insulation class of ballast winding		
14	Average life expectancy of		
a)	Ballast	(hours)	
b)	Capacitors	(hours)	
c)	Lamps	(hours)	

15	Lamp output at the design temperature		
a)	After 100 burning hours	(Lumens)	
b)	After 1000 burning hours	(Lumens)	
16	Lamp output at the end of the expected life period	(Lumens)	
17	Average light output of the fitting as a percentage of lamp output.		
a)	Downwards	(%)	
b)	Upwards	(%)	
18	Beam angle for flood lights in		
a)	Horizontal plane	(Degrees)	
b)	Vertical plane	(Degrees)	
19	a) Cable/conduit entry size	(mm)	
	b) Size and type of cable	(sq. mm)	
20	Earthing terminal		
a)	Material		
b)	Suitable for earthing conductor of size	(mm x mm)	
21	Weights of fixtures	(Kg)	
22	Starting current & PF for lamp	(Amps)	
23	Operating current	(Amps)	
24	Time vs Mains current & PF characteristics during starting enclosed	(Yes/No)	
25	Reference catalogue No.		
III.	**Receptacles with Switches**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Voltage grade	(Volts)	
4	Current rating at specified ambient temperature of 50 Degrees C		
a)	Make and carry	(Amps)	
b)	Break	(Amps)	
5	Applicable standards		
6	Whether descriptive pamphlet is enclosed?	(Yes/No)	
IV	**Lighting control switches**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Voltage grade	(Volts)	

4	Current rating at specified ambient temperature of 50 Deg. C		
a)	Make and carry	(Amps)	
b)	Break	(Amps)	
5	Applicable standards		
6	Whether descriptive pamphlet is enclosed?	(Yes/No)	
V.	**Conduits & Accessories**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Applicable standards		
4	Whether descriptive pamphlet is enclosed?	(Yes / No)	
VI.	**Junction Boxes**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Material specification		
4	Type of enclosure		
5	Terminals		
a)	Make		
b)	Current rating	(Amp)	
c)	Voltage rating	(Volts)	
d)	Stud type	(Yes/No)	
e)	Complete with insulated barriers	(Yes/No)	
6	Whether descriptive pamphlet is enclosed?	(Yes/No)	
VII.	**Pull out Boxes**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Material specification		
4	Type of enclosure		
5	Whether descriptive pamphlet is enclosed	(Yes/No)	
VIII.	**Air Break Switches**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type description		
3	Applicable standard		
4	Rated voltage & frequency	(Volts, Hz)	

5	Rated current	(Amps)	
6	Rated breaking current	(Amps)	
7	Maximum through fault current withstand, derating factor for use under site ambient conditions	(Amps)	
8	Temperature rise of contacts when carrying continuous rated current under site conditions.	(Deg. C)	
IX.	**Fuses**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type description		
3	Applicable standard		
4	Rated voltage	(Volts)	
5	Rated current	(Amp)	
6	Whether fuse is mounted in an insulated carrier	(Yes/No)	
7	Whether fuse carrier has an aperture for fuse failure indication.	(Yes/No)	
8	Category of duty (IS:2208)		
9	Rupturing capacities (Prospective current)	(kA)	
10	Maximum let through current for 1 sec.	(kA)	
11	Whether time/current characteristics are enclosed?	(Yes/No)	
X.	**Miniature circuit breaker**		
1	Manufacturer's name and country of manufacture.		
2	Type		
3	Rated voltage	(Volts)	
4	No. of poles	(Nos.)	
5	Frequency	(Hz)	
6	Current rating	(Amp)	
	a) Continuous at 50 Deg. C ambient temperature	(Amp)	
	b) 1 sec.	(kA rms)	
7	Breaking capacity for Single Phase / Double Pole / Triple Pole		
	a) Symmetrical (kA rms at volt)		
	b) Asymmetrical(kA rms at volt)		
8	Total interrupting time	(Cycle)	

9	Type of blow out device		
10	Type of overload (terminal/magnetic)		
11	Terminal suitable for cable size	(sq. mm)	
12	Upto what fault current discrimination between incomer fuse & MCB will be obtained?	(kA)	
13	Standards to which Miniature Circuit Breaker conforms		
XI.	**Contactors**		
1	Manufacturer's name and country of manufacture.		
2	Rated voltage & permissible variation	(Volts, %)	
3	Rated burden	(VA)	
4	Rated current (thermal) of main contacts	(Amp)	
5	No. & type of Aux. Contacts (if any)		
6	Rated voltage of coil	(Volts)	
7	Pick up voltage	(Volts)	
8	Rated duty class		
9	Drop off voltage	(Volts)	
10	Applicable standard		
XII.	**Lighting Wires**		
1	Manufacturer's name and country of manufacture.		
2	Standard applicable		
3	Rated voltage	(Volts)	
4	Continuous current rating when laid in conduit in ambient condition	(Amp)	
5	Conductor		
a)	Material		
b)	Nominal cross sectional area	(sq. mm)	
c)	Number & diameter of wires	(Nos. / mm)	
6	Insulation		
a)	Composition of insulation		
b)	Thickness of insulation	(mm)	
c)	Tolerance on thickness of insulation	(%)	
d)	Specific insulation resistance at 60°C		
7	Colour scheme for identification of wires		

8	Whether descriptive pamphlet is enclosed?	(Yes/No)	
XIII.	**Painting**		
1	Paints (for each type)		
a)	Manufacturer's name and country of manufacture.		
b)	Manufacturer's type designation/brand name		
c)	Shade.		
2	Number of coats provided for		
a)	Lighting poles & other fabricated steel structures	(Nos.)	
b)	Junction boxes	(Nos.)	
3	Applicable standards		

Note: 1. (N.A.) be written against the item which is not applicable.

2. Separate GTPs be given for each item under fixtures and accessories.

GUARANTEED TECHNICAL PARTICULARS OF STREET LIGHTING

Sl. No.	Description	Unit	Guaranteed Particulars
I.	Poles		
a)	Name and address of supplier		
b)	Name and address of manufacturer		
c)	Designation as per IS: 2713		
d)	Overall length (mm)		
e)	Planting depth (mm)		
f)	Height above ground (mm)		
g)	Length of section		
	Bottom (h_3) (m)		
	Middle (h2) (m)		
	Top (h1) (m)		
h)	Outside diameter and thickness of section		
	Bottom (mm)		
	Middle (mm)		
	Top (mm)		
i)	Material & standard to which conforming		
j)	Ultimate, Tensile strength (kg/mm2)		
k)	Nominal weight of Pole (kg)		
l)	Breaking load (kg)		
m)	Couping load (kgf)		
n)	Load for permanent set not exceeding 13 mm (kgf)		
o)	Load for temporary defection of 157.5 mm (kgf)		
p)	Provision of bolts at each swagged portion made and nos., diameter & length of bolts		
q)	Whether hole in bottom section provided for connecting earthing lead, dia. Of hole and height above planting depth.		
r)	Material and dimension of base plates		
s)	Details of painting		
t)	Tolerances		

	- Thickness		
	- Length		
	- Weight		
	- Straightness		
u)	Details of Taper Plug		
II.	**Lighting fixtures & Accessories**		
1	Manufacturer's name		
a)	Fixtures		
b)	Accessories		
2	Country of manufacturer for		
a)	Fixtures		
b)	Accessories		
3	Applicable standards for		
a)	Fixtures		
b)	Accessories		
4	Manufacturer's type and catalogue no. for		
a)	Fixtures		
b)	Accessories		
5	Nominal working voltage	(Volts)	
6	Maximum permissible supply voltage variation for satisfactory operation of		
a)	Fixtures	(+ %)	
b)	Accessories	(+ %)	
7	Power factor at nominal working voltage and frequency		
8	Full load output current at nominal working voltage	(Amps)	
9	Power loss per ballast at nominal working voltage & frequency	(Watts)	
10	Maximum hot spot temperatures of ballast case	(Deg. C)	
11	Maximum average ballast winding temperature	(Deg. C)	
12	Ambient temperature within the fitting in continuous operation at the design ambient air temperature	(Deg. C)	
13	Insulation class of ballast winding		
14	Average life expectancy of		
a)	Ballast	(hours)	
b)	Capacitors	(hours)	
c)	Lamps	(hours)	

15	Lamp output at the design temperature		
a)	After 100 burning hours	(Lumens)	
b)	After 1000 burning hours	(Lumens)	
16	Lamp output at the end of the expected life period	(Lumens)	
17	Average light output of the fitting as a percentage of lamp output.		
a)	Downwards	(%)	
b)	Upwards	(%)	
18	Beam angle for flood lights in		
a)	Horizontal plane	(Degrees)	
b)	Vertical plane	(Degrees)	
19	a) Cable/conduit entry size	(mm)	
	b) Size and type of cable	(sq. mm)	
20	Earthing terminal		
a)	Material		
b)	Suitable for earthing conductor of size	(mm x mm)	
21	Weights of fixtures	(Kg)	
22	Starting current & PF for lamp	(Amps)	
23	Operating current	(Amps)	
24	Time vs Mains current & PF characteristics during starting enclosed	(Yes/No)	
25	Reference catalogue No.		
III.	**Receptacles with Switches**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Voltage grade	(Volts)	
4	Current rating at specified ambient temperature of 50 Degrees C		
a)	Make and carry	(Amps)	
b)	Break	(Amps)	
5	Applicable standards		
6	Whether descriptive pamphlet is enclosed?	(Yes/No)	
IV	**Lighting control switches**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Voltage grade	(Volts)	

4	Current rating at specified ambient temperature of 50 Deg. C		
a)	Make and carry	(Amps)	
b)	Break	(Amps)	
5	Applicable standards		
6	Whether descriptive pamphlet is enclosed?	(Yes/No)	
V.	**Conduits & Accessories**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Applicable standards		
4	Whether descriptive pamphlet is enclosed?	(Yes / No)	
VI.	**Junction Boxes**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Material specification		
4	Type of enclosure		
5	Terminals		
a)	Make		
b)	Current rating	(Amp)	
c)	Voltage rating	(Volts)	
d)	Stud type	(Yes/No)	
e)	Complete with insulated barriers	(Yes/No)	
6	Whether descriptive pamphlet is enclosed?	(Yes/No)	
VII.	**Pull out Boxes**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Material specification		
4	Type of enclosure		
5	Whether descriptive pamphlet is enclosed	(Yes/No)	
VIII.	**Air Break Switches**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type description		
3	Applicable standard		
4	Rated voltage & frequency	(Volts, Hz)	

5	Rated current	(Amps)	
6	Rated breaking current	(Amps)	
7	Maximum through fault current withstand, derating factor for use under site ambient conditions	(Amps)	
8	Temperature rise of contacts when carrying continuous rated current under site conditions.	(Deg. C)	
IX.	**Fuses**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type description		
3	Applicable standard		
4	Rated voltage	(Volts)	
5	Rated current	(Amp)	
6	Whether fuse is mounted in an insulated carrier	(Yes/No)	
7	Whether fuse carrier has an aperture for fuse failure indication.	(Yes/No)	
8	Category of duty (IS:2208)		
9	Rupturing capacities (Prospective current)	(kA)	
10	Maximum let through current for 1 sec.	(kA)	
11	Whether time/current characteristics are enclosed?	(Yes/No)	
X.	**Miniature circuit breaker**		
1	Manufacturer's name and country of manufacture.		
2	Type		
3	Rated voltage	(Volts)	
4	No. of poles	(Nos.)	
5	Frequency	(Hz)	
6	Current rating	(Amp)	
	a) Continuous at 50 Deg. C ambient temperature	(Amp)	
	b) 1 sec.	(kA rms)	
7	Breaking capacity for Single Phase / Double Pole / Triple Pole		
	a) Symmetrical (kA rms at volt)		
	b) Asymmetrical(kA rms at volt)		
8	Total interrupting time	(Cycle)	

9	Type of blow out device		
10	Type of overload (terminal/magnetic)		
11	Terminal suitable for cable size	(sq. mm)	
12	Upto what fault current discrimination between incomer fuse & MCB will be obtained?	(kA)	
13	Standards to which Miniature Circuit Breaker conforms		
XI.	**Contactors**		
1	Manufacturer's name and country of manufacture.		
2	Rated voltage & permissible variation	(Volts, %)	
3	Rated burden	(VA)	
4	Rated current (thermal) of main contacts	(Amp)	
5	No. & type of Aux. Contacts (if any)		
6	Rated voltage of coil	(Volts)	
7	Pick up voltage	(Volts)	
8	Rated duty class		
9	Drop off voltage	(Volts)	
10	Applicable standard		
XII.	**Lighting Wires**		
1	Manufacturer's name and country of manufacture.		
2	Standard applicable		
3	Rated voltage	(Volts)	
4	Continuous current rating when laid in conduit in ambient condition	(Amp)	
5	Conductor		
a)	Material		
b)	Nominal cross sectional area	(sq. mm)	
c)	Number & diameter of wires	(Nos. / mm)	
6	Insulation		
a)	Composition of insulation		
b)	Thickness of insulation	(mm)	
c)	Tolerance on thickness of insulation	(%)	
d)	Specific insulation resistance at 60°C		
7	Colour scheme for identification of wires		

8	Whether descriptive pamphlet is enclosed?	(Yes/No)	
XIII.	**Painting**		
1	Paints (for each type)		
a)	Manufacturer's name and country of manufacture.		
b)	Manufacturer's type designation/brand name		
c)	Shade.		
2	Number of coats provided for		
a)	Lighting poles & other fabricated steel structures	(Nos.)	
b)	Junction boxes	(Nos.)	
3	Applicable standards		

Note: 1. (N.A.) be written against the item which is not applicable.

2. Separate GTPs be given for each item under fixtures and accessories.

9 GUARANTEED TECHNICAL PARTICULARS OF COMPOUND LIGHTING

Sl. No.	Description	Unit	Guaranteed Particulars
I.	Poles		
a)	Name and address of supplier		
b)	Name and address of manufacturer		
c)	Designation as per IS: 2713		
d)	Overall length (mm)		
e)	Planting depth (mm)		
f)	Height above ground (mm)		
g)	Length of section		
	Bottom (h_3) (m)		
	Middle (h2) (m)		
	Top (h1) (m)		
h)	Outside diameter and thickness of section		
	Bottom (mm)		
	Middle (mm)		
	Top (mm)		
i)	Material & standard to which conforming		
j)	Ultimate, Tensile strength (kg/mm2)		
k)	Nominal weight of Pole (kg)		
l)	Breaking load (kg)		
m)	Couping load (kgf)		
n)	Load for permanent set not exceeding 13 mm (kgf)		
o)	Load for temporary defection of 157.5 mm (kgf)		
p)	Provision of bolts at each swagged portion made and nos., diameter & length of bolts		
q)	Whether hole in bottom section provided for connecting earthing lead, dia. Of hole and height above planting depth.		
r)	Material and dimension of base plates		
s)	Details of painting		
t)	Tolerances		
	- Thickness		
	- Length		
	- Weight		
	- Straightness		

u)	Details of Taper Plug		
II.	Lighting fixtures & Accessories		
1	Manufacturer's name		
a)	Fixtures		
b)	Accessories		
2	Country of manufacturer for		
a)	Fixtures		
b)	Accessories		
3	Applicable standards for		
a)	Fixtures		
b)	Accessories		
4	Manufacturer's type and catalogue no. for		
a)	Fixtures		
b)	Accessories		
5	Nominal working voltage	(Volts)	
6	Maximum permissible supply voltage variation for satisfactory operation of		
a)	Fixtures	(+%)	
b)	Accessories	(+%)	
7	Power factor at nominal working voltage and frequency		
8	Full load output current at nominal working voltage	(Amps)	
9	Power loss per ballast at nominal working voltage & frequency	(Watts)	
10	Maximum hot spot temperatures of ballast case	(Deg. C)	
11	Maximum average ballast winding temperature	(Deg. C)	
12	Ambient temperature within the fitting in continuous operation at the design ambient air temperature	(Deg. C)	
13	Insulation class of ballast winding		
14	Average life expectancy of		
a)	Ballast	(hours)	
b)	Capacitors	(hours)	
c)	Lamps	(hours)	
15	Lamp output at the design temperature		
a)	After 100 burning hours	(Lumens)	
b)	After 1000 burning hours	(Lumens)	
16	Lamp output at the end of the expected life period	(Lumens)	
17	Average light output of the fitting as a percentage of lamp output.		
a)	Downwards	(%)	
b)	Upwards	(%)	
18	Beam angle for flood lights in		

a)	Horizontal plane	(Degrees)	
b)	Vertical plane	(Degrees)	
19	a) Cable/conduit entry size	(mm)	
	b) Size and type of cable	(sq. mm)	
20	Earthing terminal		
a)	Material		
b)	Suitable for earthing conductor of size	(mm x mm)	
21	Weights of fixtures	(Kg)	
22	Starting current & PF for lamp	(Amps)	
23	Operating current	(Amps)	
24	Time vs Mains current & PF characteristics during starting enclosed	(Yes/No)	
25	Reference catalogue No.		
III.	**Receptacles with Switches**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Voltage grade	(Volts)	
4	Current rating at specified ambient temperature of 50 Degrees C		
a)	Make and carry	(Amps)	
b)	Break	(Amps)	
5	Applicable standards		
6	Whether descriptive pamphlet is enclosed?	(Yes/No)	
IV	**Lighting control switches**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Voltage grade	(Volts)	
4	Current rating at specified ambient temperature of 50 Deg. C		
a)	Make and carry	(Amps)	
b)	Break	(Amps)	
5	Applicable standards		
6	Whether descriptive pamphlet is enclosed?	(Yes/No)	
V.	**Conduits & Accessories**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Applicable standards		
4	Whether descriptive pamphlet is enclosed?	(Yes / No)	
VI.	**Junction Boxes**		
1	Manufacturer's name and country of manufacture.		

2	Manufacturer's type designation.		
3	Material specification		
4	Type of enclosure		
5	Terminals		
a)	Make		
b)	Current rating	(Amp)	
c)	Voltage rating	(Volts)	
d)	Stud type	(Yes/No)	
e)	Complete with insulated barriers	(Yes/No)	
6	Whether descriptive pamphlet is enclosed?	(Yes/No)	
VII.	**Pull out Boxes**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type designation.		
3	Material specification		
4	Type of enclosure		
5	Whether descriptive pamphlet is enclosed	(Yes/No)	
VIII.	**Air Break Switches**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type description		
3	Applicable standard		
4	Rated voltage & frequency	(Volts, Hz)	
5	Rated current	(Amps)	
6	Rated breaking current	(Amps)	
7	Maximum through fault current withstand, derating factor for use under site ambient conditions	(Amps)	
8	Temperature rise of contacts when carrying continuous rated current under site conditions.	(Deg. C)	
IX.	**Fuses**		
1	Manufacturer's name and country of manufacture.		
2	Manufacturer's type description		
3	Applicable standard		
4	Rated voltage	(Volts)	
5	Rated current	(Amp)	
6	Whether fuse is mounted in an insulated carrier	(Yes/No)	
7	Whether fuse carrier has an aperture for fuse failure indication.	(Yes/No)	
8	Category of duty (IS:2208)		
9	Rupturing capacities (Prospective current)	(kA)	

10	Maximum let through current for 1 sec.	(kA)	
11	Whether time/current characteristics are enclosed?	(Yes/No)	
X.	**Miniature circuit breaker**		
1	Manufacturer's name and country of manufacture.		
2	Type		
3	Rated voltage	(Volts)	
4	No. of poles	(Nos.)	
5	Frequency	(Hz)	
6	Current rating	(Amp)	
	a) Continuous at 50 Deg. C ambient temperature	(Amp)	
	b) 1 sec.	(kA rms)	
7	Breaking capacity for Single Phase / Double Pole / Triple Pole		
	a) Symmetrical (kA rms at volt)		
	b) Asymmetrical(kA rms at volt)		
8	Total interrupting time	(Cycle)	
9	Type of blow out device		
10	Type of overload (terminal/magnetic)		
11	Terminal suitable for cable size	(sq. mm)	
12	Upto what fault current discrimination between incomer fuse & MCB will be obtained?	(kA)	
13	Standards to which Miniature Circuit Breaker conforms		
XI.	**Contactors**		
1	Manufacturer's name and country of manufacture.		
2	Rated voltage & permissible variation	(Volts, %)	
3	Rated burden	(VA)	
4	Rated current (thermal) of main contacts	(Amp)	
5	No. & type of Aux. Contacts (if any)		
6	Rated voltage of coil	(Volts)	
7	Pick up voltage	(Volts)	
8	Rated duty class		
9	Drop off voltage	(Volts)	
10	Applicable standard		
XII.	**Lighting Wires**		
1	Manufacturer's name and country of manufacture.		
2	Standard applicable		
3	Rated voltage	(Volts)	
4	Continuous current rating when laid in conduit in ambient condition	(Amp)	
5	Conductor		

a)	Material		
b)	Nominal cross sectional area	(sq. mm)	
c)	Number & diameter of wires	(Nos. / mm)	
6	Insulation		
a)	Composition of insulation		
b)	Thickness of insulation	(mm)	
c)	Tolerance on thickness of insulation	(%)	
d)	Specific insulation resistance at 60°C		
7	Colour scheme for identification of wires		
8	Whether descriptive pamphlet is enclosed?	(Yes/No)	
XIII.	Painting		
1	Paints (for each type)		
a)	Manufacturer's name and country of manufacture.		
b)	Manufacturer's type designation/brand name		
c)	Shade.		
2	Number of coats provided for		
a)	Lighting poles & other fabricated steel structures	(Nos.)	
b)	Junction boxes	(Nos.)	
3	Applicable standards		

Note: 1. (N.A.) be written against the item which is not applicable.
2. Separate GTPs be given for each item under fixtures and accessories.

10

MISCELLANEOUS ITEMS

Sl. No.	Description	Unit	Specific Requirements	Guaranteed Particulars
1	**GI SPIKE EARTHING SET**			
a)	Name and address of supplier/manufacturer			
b)	Bill of material and standard to which conforming			
c)	Dimensional drawings			
d)	Details of earthing load			
	- Nos. and dia of wires			
	- Stress (kg/mm2)			
	UTS (kg)			
	Galvanisation			
	- Process			
	- Mass of zinc			
	- No. of dips			
	1 minute			
	1/2 minute			
	- Quality of zinc and standard to which conforming			
e)	Earthing spike			
	- Material			
	- Stress (kg/mm2)			
	- UTS (kg)			
	- Galvanisation			
	- Process			
	- Mass of Zinc			
	- Quality of zinc and standard to which conforming			
2	**DANGER PLATE**			
a)	Name and address of supplier/manufacturer			
b)	Bill of material and standard to which conforming			
c)	Dimensional drawings showing location of fixing holes			
d)	Details of paint			
	- Type			
	- Colour			
e)	Details of treatment given to make weather proof			
f)	Whether covers of the plate rounded (Yes/No)			
3	**GALVANISED STRANDED STEEL EARTHWIRE**			
1	Material		Steel	

2	Purity of Material	(%)	Sulphur and Phosphorus content each 0.05% (Max.) Carbon content 0.55% (Max.)	
3	Stranding and wire diameter	(mm)	7/3.66	
4	No. of strands	(Nos.)	Steel core - 1; Outer steel layer - 6	
5	Weight	(Kg/km)	575	
6	Single wire before stranding			
	a) Diameter of wire strand	(mm)	3.66	
	Maximum	(mm)	3.74	
	Minimum	(mm)	3.58	
	b) Minimum elongation in 200 mm length	(%)	4%	
	c) Minimum tensile strength	(N/sq. mm)	981	
	d) D.C. resistance at 20 Deg. C	(Ohms/km)	17.15	
7	Stranded wire			
	a) Length of lay			
	Maximum	(mm)	307	
	Minimum	(mm)	143	
	b) Minimum breaking load	(kN)	6972 Kg or 68.4 kN	
	c) Overall diameter	(mm)	10.98	
	d) Modulus of elasticity	(Kg/sq. mm)	19.0×10^3	
	e) Coefficient of linear expansion	(per Deg. C)	11.50×10^{-6}	
	f) D.C. resistance at 20 degC	(Ohms/km)	2.5	
	g) Total sectional area	(sq. mm)	73.65	
8	Direction of lay of outer layer		Right Hand	
9	Zinc coating			
	a) Number of one minute		3	
	b) Number of half minute dips		1	
	c) Quality of Zinc	(%)	Zn 98 to IS: 209	
	d) Weight of coating on wire	(gm/sq. m)	260	
	e) Process of galvanising		HDG	
10	Joints		Not permitted.	
11	Oiling		Dipped in boiled linseed oil.	
12	Chemical composition			
	Element			
	i) Carbon	(%)	0.55 (Max.)	
	ii) Manganese	(%)	0.4 to 1.10	
	iii) Phosphorus	(%)	0.05 (Max.)	
	iv) Sulphur	(%)	0.05 (Max.)	
	v) Silicon	(%)	0.15 to 0.35	

4	EARTHING			
1	General			
a)	Specification / Standards followed			
b)	Design ambient temperature	(Deg. C)	As per substation site data	
c)	Areas of switchyard (L x W)	(m x m)		
d)	Average soil resistivity	(Ohm-m)		
e)	Type of soil (homogenous / non-homogenous)			
f)	Degree of corrosive nature of soil			
2	Earthing mat data			
a)	Area under which the mat will be laid (L x W)	(m x m)		
b)	Termination distance of earthing mat with reference to switchyard fencing	(m)		
c)	Depth of burial of earthing mat	(m)	0.6 (Min.)	
d)	Size of earthing mat grids (L x W)	(m x m)		
e)	Details of switchyard earthing mat conductor			
	i) Size material and shape	(mm)	40 mm dia MS Rod	
	ii) Allowance made for corrosion	(%)		
	iii) Length of conductor	(m)		
	iv) Weight	(Kg)		
f)	Detail of risers			
	i) Size material and shape	(Sq.mm)		
	ii) Allowance made for corrosion	(%)		
	iii) Length of conductor	(m)		
	iv) Weight	(Kg)		
g)	Details of conductor for connections to earthing points of current carrying parts			
	i) Size material and shape	(Sq.mm)		

	ii) Allowance made for corrosion	(%)		
	iii) Length of conductor	(m)		
	iv) Weight	(Kg)		
h)	Details of conductors for connection to non-current carrying parts			
	i) Size material and shape	(Sq.mm)		
	ii) Allowance made for corrosion	(%)		
	iii) Length of conductor	(m)		
	iv) Weight	(Kg)		
3	Equipment earthing electrode systems			
a)	Details of earthing system for potential transformers			
	i) Number and material of earthing electrodes	(Nos.)		
	ii) Diameter and length of electrode	(mm, mm)		
	iii) Size and material of conductors	(mm)		
b)	Details of earthing system for capacitor voltage transformers			
	i) Number and material of earthing electrodes	(Nos.)		
	ii) Diameter and length of electrode	(mm, mm)		
	iii) Size and material of conductors	(mm)		
c)	Details of earthing system for lightning arrestors			
	i) Number and material of earthing electrodes	(Nos.)		
	ii) Diameter and length of electrode	(mm, mm)		

	iii) Size and material of	(mm)		
4	Fault current for which the earthing mat is designed	(kA)	40	
5	Duration of fault assumed for design	(seconds)	1	
6	Duration of shock	(seconds)	0.5	
7	Resistivity of surface layer	(Ohm-m)	3000	
8	Size of crushed rock and thickness of layer	(mm)	15-20, 150	
9	Estimated value of earthing mat resistance	(Ohms)	1.0 (Max.)	
10	Estimated values of			
a)	Touch potential	(Volts)		
b)	Step potential	(Volts)		
c)	Ground potential rise	(Volts)		
d)	Transferred potential	(Volts)		
11	Measures envisaged to be taken to limit the various potentials within safe limits, if the estimated values are found to exceed the safe limits.			
12	Size of weld for welded joints	(mm)		
13	Number of diameter of bolts for bolted joints	(m)		
14	Locations where bolted joints shall be provided			
15	Protection measures against corrosion of			
a)	Welds		Treated with Barium Chromate. Then painted with red	
b)	Earthing mat conductors			
c)	Bolted connections			
d)	Risers and other connectors		Painted with bituminous paint.	

16	Drawings (Attach drawings showing details of earthing mat, arrangements for connections to various system, equipment fence etc., details of welds, bolted joints etc., and bill of materials as per this specification)			
17	Tests			
18	List of tests that the bidder will carry out			
5	**COMPRESSION TYPE CABLE GLAND**			
1	Manufacturer's Name & Address			
2	Manufacturer's type designation			
3	Material		Brass (Tinned / Nickel plated)	
4	Whether passivated or not	(Yes/No)		
6	**CABLE LUGS**			
1	Manufacturer's Name & Address			
2	Manufacturer's type designation			
3	Current rating	(Amp)		
4	Material specification		Copper (Tinned) to IS: 8309 / IS: 8394	
5	Tinned	(Yes/No)		
6	Solder less crimping type	(Yes/No)		
7	**FIRE FIGHTING EQUIPMENT**			
a)	**SAND / WATER BUCKETS**			
1	Manufacturer			
2	Standard to which it conforms			
3	Capacity	(cu. m)		
4	Number provided			
5	Provided with hanging arrangement	(Yes/No)		
6	Whether approved by TAC?	(Yes/No)		
b)	**DRY POWDER TYPE EXTINGUISHER**			
1	Manufacturer			
2	Principle of operation			
3	Capacity	(cu. m)		
4	Type of extinguisher (Low/High pressure)			
5	Shape			
6	Material of construction			
	a) Body			
	b) Inner shell			
	c) Neck ring			
	d) Cap			
	e) Plunger			

	f) Cartridge holder and sealing device		
	g) Piercer		
	h) Spring		
	i) Syphon tube		
	j) Nozzle and discharge fittings		
	k) Cartridge		
	l) Hose		
7	Range of throw of jet	(m)	
8	Whether dry powder charge conforms to IS 4308	(Yes/No)	
9	Max. period of discharging 95% of chemical	(Sec)	
10	Test pressure for extinguisher body	(kg/sq. cm)	
11	Whether handle provided	(Yes/No)	
12	Whether seal provided to indicate that extinguisher has not been used	(Yes/No)	
13	Whether anti-corrosive treatment provided?	(Yes/No)	
14	Whether First charge of chemical supplied?	(Yes/No)	
15	List of accessories provided	(Yes/No)	
16	Painting		
17	Whether extinguisher is capable of discharging not less than 85% by mass of the actual rated capacity of dry powder at an angle of 45	(Yes/No)	
18	List of Test certificate provided	(Yes/No)	
19	Standard to which it conforms		
20	Whether approved by TAC?	(Yes/No)	
21	Whether each extinguisher has the marking as per IS 2171	(Yes/No)	
22	Whether approved by the chief inspector of explosives Govt, of	(Yes/No)	
23	Whether illustrative leaflets attached	(Yes/No)	
c)	**PORTABLE CARBON DIOXIDE EXTINGUISHER**		
1	Manufacturer		
2	Capacity	(cu. m)	

3	Number provided	(Nos.)	
4	Material of construction:		
	a) Brass tube		
	b) Siphon or discharge tube		
	c) Wheel of operating head		
	d) Body		
	e) Discharge valve or operating head		
	f) Hose		
	g) Discharge horn		
	h) Carrying handle		
5	Type of valve provided		
6	Standard to which it conforms		
7	Provided with handling arrangement	(Yes/No)	
8	Whether seal to indicate that extinguisher has not been used provided?	(Yes/No)	
9	Whether safety release provided?	(Yes/No)	
10	Whether supplied with first charge of extinguisher agent?	(Yes/No)	
11	Whether each extinguisher has the marking as per IS 2878	(Yes/No)	
12	Whether approved by TAC?	(Yes/No)	
13	Whether approved by the chief inspector of explosive Govt. of India	(Yes/No)	
14	Whether illustrative leaflets	(Yes/No)	
15	List of Test certificate provided	(Yes/No)	
16	Standard to which CO_2 extinguisher conforms		
d)	**FOAM TYPE PORTABLE EXTINGUISHER**		
1	Manufacturer		
2	Standard to which it conforms		
3	Type		
4	Capacity	(cu. m)	
5	Number provided	(Nos.)	
6	Max. effective range when tested in still air	(m)	

7	Min. period during which jet shall be maintained at a length of not	(Sec)	
8	Max. period for discharging 95% solution	(Sec)	
9	Test pressure for extinguisher body	(kg/sq. cm)	
10	Test pressure for hose	(kg/sq. cm)	
11	Whether handle is provided?	(Yes/No)	
12	Whether provided with hanging arrangement	(Yes/No)	
13	Whether provided seal to indicate that extinguisher has not been used	(Yes/No)	
14	Supplied with first charge of chemical	(Yes/No)	
15	List of accessories provided	(Yes/No)	
16	Whether each extinguisher has the marking as per IS	(Yes/No)	
17	Whether approved by TAC?	(Yes/No)	
18	Whether illustrative leaflets attached	(Yes/No)	
19	Test Certificates enclosed	(Yes/No)	

Note: -(N.A.) be written against the item which is not applicable.

Signature :

10

MISCELLANEOUS ITEMS

Sl. No.	Description	Unit	Specific Requirements	Guaranteed Particulars
1	**GI SPIKE EARTHING SET**			
a)	Name and address of supplier/manufacturer			
b)	Bill of material and standard to which conforming			
c)	Dimensional drawings			
d)	Details of earthing load			
	- Nos. and dia of wires			
	- Stress (kg/mm2)			
	UTS (kg)			
	Galvanisation			
	- Process			
	- Mass of zinc			
	- No. of dips			
	1 minute			
	1/2 minute			
	- Quality of zinc and standard to which conforming			
e)	Earthing spike			
	- Material			
	- Stress (kg/mm2)			
	- UTS (kg)			
	- Galvanisation			
	- Process			
	- Mass of Zinc			
	- Quality of zinc and standard to which conforming			
2	**DANGER PLATE**			
a)	Name and address of supplier/manufacturer			
b)	Bill of material and standard to which conforming			
c)	Dimensional drawings showing location of fixing holes			
d)	Details of paint			
	- Type			
	- Colour			
e)	Details of treatment given to make weather proof			
f)	Whether covers of the plate rounded (Yes/No)			
3	**GALVANISED STRANDED STEEL EARTHWIRE**			
1	Material		Steel	

2	Purity of Material	(%)	Sulphur and Phosphorus content each 0.05% (Max.) Carbon content 0.55% (Max.)	
3	Stranding and wire diameter	(mm)	7/3.66	
4	No. of strands	(Nos.)	Steel core - 1; Outer steel layer - 6	
5	Weight	(Kg/km)	575	
6	Single wire before stranding			
	a) Diameter of wire strand	(mm)	3.66	
	Maximum	(mm)	3.74	
	Minimum	(mm)	3.58	
	b) Minimum elongation in 200 mm length	(%)	4%	
	c) Minimum tensile strength	(N/sq. mm)	981	
	d) D.C. resistance at 20 Deg. C	(Ohms/km)	17.15	
7	Stranded wire,			
	a) Length of lay			
	Maximum	(mm)	307	
	Minimum	(mm)	143	
	b) Minimum breaking load	(kN)	6972 Kg or 68.4 kN	
	c) Overall diameter	(mm)	10.98	
	d) Modulus of elasticity	(Kg/sq. mm)	19.0×10^{3}	
	e) Coefficient of linear expansion	(per Deg. C)	11.50×10^{-6}	
	f) D.C. resistance at 20 degC	(Ohms/km)	2.5	
	g) Total sectional area	(sq. mm)	73.65	
8	Direction of lay of outer layer		Right Hand	
9	Zinc coating			
	a) Number of one minute		3	
	b) Number of half minute dips		1	
	c) Quality of Zinc	(%)	Zn 98 to IS: 209	
	d) Weight of coating on wire	(gm/sq. m)	260	
	e) Process of galvanising		HDG	
10	Joints		Not permitted.	
11	Oiling		Dipped in boiled linseed oil.	
12	Chemical composition			
	Element			
	i) Carbon	(%)	0.55 (Max.)	
	ii) Manganese	(%)	0.4 to 1.10	
	iii) Phosphorus	(%)	0.05 (Max.)	
	iv) Sulphur	(%)	0.05 (Max.)	
	v) Silicon	(%)	0.15 to 0.35	

4	EARTHING			
1	General			
a)	Specification / Standards followed			
b)	Design ambient temperature	(Deg. C)	As per substation site data	
c)	Areas of switchyard (L x W)	(m x m)		
d)	Average soil resistivity	(Ohm-m)		
e)	Type of soil (homogenous / non-homogenous)			
f)	Degree of corrosive nature of soil			
2	Earthing mat data			
a)	Area under which the mat will be laid (L x W)	(m x m)		
b)	Termination distance of earthing mat with reference to switchyard fencing	(m)		
c)'	Depth of burial of earthing mat	(m)	0.6 (Min.)	
d)	Size of earthing mat grids (L x W)	(m x m)		
e)	Details of switchyard earthing mat conductor			
	i) Size material and shape	(mm)	40 mm dia MS Rod	
	ii) Allowance made for corrosion	(%)		
	iii) Length of conductor	(m)		
	iv) Weight	(Kg)		
f)	Detail of risers			
	i) Size material and shape	(Sq.mm)		
	ii) Allowance made for corrosion	(%)		
	iii) Length of conductor	(m)		
	iv) Weight	(Kg)		
g)	Details of conductor for connections to earthing points of current carrying parts			
	i) Size material and shape	(Sq.mm)		

	ii) Allowance made for corrosion	(%)		
	iii) Length of conductor	(m)		
	iv) Weight	(Kg)		
h)	Details of conductors for connection to non-current carrying parts			
	i) Size material and shape	(Sq.mm)		
	ii) Allowance made for corrosion	(%)		
	iii) Length of conductor	(m)		
	iv) Weight	(Kg)		
3	Equipment earthing electrode systems			
a)	Details of earthing system for potential transformers			
	i) Number and material of earthing electrodes	(Nos.)		
	ii) Diameter and length of electrode	(mm, mm)		
	iii) Size and material of conductors	(mm)		
b)	Details of earthing system for capacitor voltage transformers			
	i) Number and material of earthing electrodes	(Nos.)		
	ii) Diameter and length of electrode	(mm, mm)		
	iii) Size and material of conductors	(mm)		
c)	Details of earthing system for lightning arrestors			
	i) Number and material of earthing electrodes	(Nos.)		
	ii) Diameter and length of electrode	(mm, mm)		

	iii) Size and material of	(mm)		
4	Fault current for which the earthing mat is designed	(kA)	40	
5	Duration of fault assumed for design	(seconds)	1	
6	Duration of shock	(seconds)	0.5	
7	Resistivity of surface layer	(Ohm-m)	3000	
8	Size of crushed rock and thickness of layer	(mm)	15-20, 150	
9	Estimated value of earthing mat resistance	(Ohms)	1.0 (Max.)	
10	Estimated values of			
a)	Touch potential	(Volts)		
b)	Step potential	(Volts)		
c)	Ground potential rise	(Volts)		
d)	Transferred potential	(Volts)		
11	Measures envisaged to be taken to limit the various potentials within safe limits, if the estimated values are found to exceed the safe limits.			
12	Size of weld for welded joints	(mm)		
13	Number of diameter of bolts for bolted joints	(m)		
14	Locations where bolted joints shall be provided			
15	Protection measures against corrosion of			
a)	Welds		Treated with Barium Chromate. Then painted with red	
b)	Earthing mat conductors			
c)	Bolted connections			
d)	Risers and other connectors		Painted with bituminous paint.	

16	Drawings (Attach drawings showing details of earthing mat, arrangements for connections to various system, equipment fence etc., details of welds, bolted joints etc., and bill of materials as per this specification)			
17	Tests			
18	List of tests that the bidder will carry out			
5	**COMPRESSION TYPE CABLE GLAND**			
1	Manufacturer's Name & Address			
2	Manufacturer's type designation			
3	Material		Brass (Tinned / Nickel plated)	
4	Whether passivated or not	(Yes/No)		
6	**CABLE LUGS**			
1	Manufacturer's Name & Address			
2	Manufacturer's type designation			
3	Current rating	(Amp)		
4	Material specification		Copper (Tinned) to IS: 8309 / IS: 8394	
5	Tinned	(Yes/No)		
6	Solder less crimping type	(Yes/No)		
7	**FIRE FIGHTING EQUIPMENT**			
a)	**SAND / WATER BUCKETS**			
1	Manufacturer			
2	Standard to which it conforms			
3	Capacity	(cu. m)		
4	Number provided			
5	Provided with hanging arrangement	(Yes/No)		
6	Whether approved by TAC?	(Yes/No)		
b)	**DRY POWDER TYPE EXTINGUISHER**			
1	Manufacturer			
2	Principle of operation			
3	Capacity	(cu. m)		
4	Type of extinguisher (Low/High pressure)			
5	Shape			
6	Material of construction			
	a) Body			
	b) Inner shell			
	c) Neck ring			
	d) Cap			
	e) Plunger			

	f) Cartridge holder and sealing device		
	g) Piercer		
	h) Spring		
	i) Syphon tube		
	j) Nozzle and discharge fittings		
	k) Cartridge		
	l) Hose		
7	Range of throw of jet	(m)	
8	Whether dry powder charge conforms to IS 4308	(Yes/No)	
9	Max. period of discharging 95% of chemical	(Sec)	
10	Test pressure for extinguisher body	(kg/sq. cm)	
11	Whether handle provided	(Yes/No)	
12	Whether seal provided to indicate that extinguisher has not been used	(Yes/No)	
13	Whether anti-corrosive treatment provided?	(Yes/No)	
14	Whether First charge of chemical supplied?	(Yes/No)	
15	List of accessories provided	(Yes/No)	
16	Painting		
17	Whether extinguisher is capable of discharging not less than 85% by mass of the actual rated capacity of dry powder at an angle of 45	(Yes/No)	
18	List of Test certificate provided	(Yes/No)	
19	Standard to which it conforms		
20	Whether approved by TAC?	(Yes/No)	
21	Whether each extinguisher has the marking as per IS 2171	(Yes/No)	
22	Whether approved by the chief inspector of explosives Govt, of	(Yes/No)	
23	Whether illustrative leaflets attached	(Yes/No)	
c)	**PORTABLE CARBON DIOXIDE EXTINGUISHER**		
1	Manufacturer		
2	Capacity	(cu. m)	

3	Number provided	(Nos.)	
4	Material of construction:		
	a) Brass tube		
	b) Siphon or discharge tube		
	c) Wheel of operating head		
	d) Body		
	e) Discharge valve or operating head		
	f) Hose		
	g) Discharge horn		
	h) Carrying handle		
5	Type of valve provided		
6	Standard to which it conforms		
7	Provided with handling arrangement	(Yes/No)	
8	Whether seal to indicate that extinguisher has not been used provided?	(Yes/No)	
9	Whether safety release provided?	(Yes/No)	
10	Whether supplied with first charge of extinguisher agent?	(Yes/No)	
11	Whether each extinguisher has the marking as per IS 2878	(Yes/No)	
12	Whether approved by TAC?	(Yes/No)	
13	Whether approved by the chief inspector of explosive Govt. of India	(Yes/No)	
14	Whether illustrative leaflets	(Yes/No)	
15	List of Test certificate provided	(Yes/No)	
16	Standard to which CO_2 extinguisher conforms		
d)	**FOAM TYPE PORTABLE EXTINGUISHER**		
1	Manufacturer		
2	Standard to which it conforms		
3	Type		
4	Capacity	(cu. m)	
5	Number provided	(Nos.)	
6	Max. effective range when tested in still air	(m)	

7	Min. period during which jet shall be maintained at a length of not	(Sec)	
8	Max. period for discharging 95% solution	(Sec)	
9	Test pressure for extinguisher body	(kg/sq. cm)	
10	Test pressure for hose	(kg/sq. cm)	
11	Whether handle is provided?	(Yes/No)	
12	Whether provided with hanging arrangement	(Yes/No)	
13	Whether provided seal to indicate that extinguisher has not been used	(Yes/No)	
14	Supplied with first charge of chemical	(Yes/No)	
15	List of accessories provided	(Yes/No)	
16	Whether each extinguisher has the marking as per IS	(Yes/No)	
17	Whether approved by TAC?	(Yes/No)	
18	Whether illustrative leaflets attached	(Yes/No)	
19	Test Certificates enclosed	(Yes/No)	

Note: (N.A.) be written against the item which is not applicable.

Signature :