BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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ILLUMINATION SYSTEM				DATE			11/5/15
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CUSTOMER	UPPTCL
CONSULTANT	Power Grid Corporation of India Ltd.
PROJECTS	765kV/400kV Agra UPPTCL(New) Substation associated with transmission system for evacuation of power from Lalitpur TPP

CONTENTS

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS			
				Distribution	*TBMM*	*TBQM*	*TBCM*	*TBTS*
				Copies	2	-	-	-

SECTION-1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 The illumination System is required for the following project.

Name of Customer : UPPTCL
Name of Consultant : Power Grid Corporation of India Ltd.

Name of the Project : 765kV/400kV Agra UPPTCL(New) Substation associated with transmission system for evacuation of power from Lalitpur TPP

Refer Section - 3 for Project Details and General Specifications

1.1 SCOPE

This specification covers the specific technical requirements of Illumination system Comprising

a) Design, engineering, manufacture, Supply, testing at works, packing and dispatch of equipment & material to site.
b) Erection, testing and commissioning.

The Illumination System shall be provided for the following areas:

- Switchyard Area
- Switchyard Control Room cum Administrative Office Building
- Fire Fighting Pump house
- Street lighting (street lighting shall be done using *"Solar based energy efficient pole mounted lighting system"*
- DG area lighting
- LT Transformer area

Complete lighting and illumination for the switchyard including street lighting, Control Room cum Administrative Building, Fire Fighting Pump house, Switchyard panel room, and LT station shall be provided by the bidder as per BOQ.

The roads & the area of the outdoor switchyard to be illuminated are as marked on the enclosed drawings under Annexure –1. Other relevant drawings are also enclosed under Annexure –1.

In case of variance in the requirements specified under Section-I and other Sections of this specification, requirements of Customer Specification / Section-I shall prevail. In case of variance in the requirements specified in Section-2 & 3, Section-3 shall prevail.

The Contract shall be on item rate basis for the Outdoor Switchyard. However, for indoor areas it shall be on lump sum basis. In case of change in the requirement for Outdoor Switchyard during detailed design after placement of order, additions / deletions to the scope shall be settled as per unit rates furnished in the Contract. There shall not be any change in price for indoor lighting.

After placement of order, the bidder has to design the system as per relevant standards/codes, practice to the satisfaction of BHEL/ ultimate Customer i.e. PGCIL.

It is not the indent to specify herein all the details of design and manufacture. The equipment and the system shall conform in all respects to high standards of design,

engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Purchaser / Owner, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work and material, which in his judgment is not in full accordance herewith.

The Bidder shall have deemed to have understood completely all the tender drawings and documents and quoted accordingly.

In case of any deviation, the bidder shall indicate separately the clause wise deviation with respect to the specification in the "Schedule of deviations". Deviations in any other form including clarifications / assumptions etc. will not be considered and it will be construed as the bid conforming strictly to the specification. Deviations pertaining to non-availability of specified equipment / material in the market or pertaining to economy in offer will only be considered.

The term " Owner" appearing in this specification shall refer to ultimate Customer, the term " Purchaser " shall refer to BHEL and the term " Contractor " shall refer to the successful Bidder.

It is the responsibility of the successful Bidder to obtain necessary approval/clearance from statutory organizations wherever applicable for the equipment/system under the scope specified.

2.0 DESIGN CRITERIA

2.1 The illumination System for outdoor Switchyard shall comprise of:

- ❑ Normal AC lighting
- ❑ Emergency AC Lighting

The illumination System for Control room and other buildings shall comprise of:

- ❑ Normal AC Lighting
- ❑ Emergency AC Lighting
- ❑ Emergency DC Lighting

25% of lighting fixtures shall be connected on AC emergency lighting.

2.2 The lux levels to be maintained in the switchyard shall be as per following:

Sl.No.	Area	Lux Level			
1.	Control Room Building, Fire Fighting Pump House	**Sl.No**	**Area**		**Average Lux level at floor level**
		i	Control Room & Conference room	-	350 Lux
		ii	Battery room. Passage, Pantry, Toilets, Corridors etc	-	100 Lux
		iii	All other rooms	-	200 Lux

2.3 The outdoor switchyard shall be illuminated using 2X400W/1X400W flood lights as required. BOQ has been given by Customer.

2.4 In an area, the lighting fixtures shall be arranged in different phase / LPs such that even in case one lighting panel is faulty complete lighting is not affected. In case of any location the lighting shall be arranged from all three phases for normal as well as normal/emergency supply.

2.5 Detailed lighting design calculations considering the number of fittings as per BOQ shall be submitted by contractor for approval of BHEL / ultimate customer.

2.6 The maintenance factors to be considered in design are :

Indoor area : 0.8

2.7 The minimum lux level to average lux level ratio should not be less than 0.6 (i.e Emin / Eav>0.6).

2.8 The detailed drawings showing lighting layout, disposition and location of lighting fixtures, receptacles, switchboards, ceiling fan points etc, wiring scheme, wiring & conduit layout, fixing details, OGAs of all equipment, Cable schedule for switchyard etc shall be submitted for approval.

3.0 SCOPE OF SUPPLIES & SERVICES

3.1 The equipment / services to be furnished for Substations under this contact are detailed hereunder and shall be read in conjunction with other clauses of this specification. All such items though not specifically mentioned but required to meet specification and for safe and satisfactory operation of equipment/ system will also be treated as included and the same shall be supplied at NO EXTRA COST to Purchaser. Further, in case any item not included below but are required to meet the technical specification, to be brought out by bidder at tender stage itself. Such items may be mentioned and included under separate head in the table below.

3.2 Tentative quantities are given below. Actual quantities to be supplied shall be as per the quantities approved based on design drawings. Bidder has to workout the design and indicate at bid stage, if change in quantity is required.

3.3 The Following shall be free issue items :

(a) Multicore Power Cables (listed in BOQ)
(b) 50X6 Galvanized strip for earthing, 40 dia MS Rod for earthing of Poles.

Erection, testing and commissioning of these cables & earth strip will be in bidder's scope. Supply of all other cables, wires, steel wire, lugs, glands, earthing material etc required are in bidder's scope.

3.4 The sizes of cables indicated are tentative. Actual size required shall be as decided at detailed engineering stage. ETC rate quoted shall remain same even if size changes.

3.5 Where cables to be laid in GI Pipe, excavation, filling etc. deemed to be included in erection cost quoted.

3.6 Bidder shall indicate in his offer catalogue numbers of all equipment offered.

3.7 *Commissioning Spares* :

Contractor shall take commissioning spares required to site to commission the system without delay. The Contractor shall finalize the list with BHEL during detailed engineering stage.

3.8 SCOPE OF SERVICES

The bidder shall quote for ETC, civil works, cable termination & earthing against each item as applicable.

ERECTION, TESTING AND COMMISSIONING

a. The Contractor shall give the offer for Erection, Testing and Commissioning of the Illumination Equipment at Site.
b. The scope of ETC shall include receipt of material at site, safe storage of material, handling of equipment/ material at site, erection of equipment / material at site including fabrication, equipment and system testing, commissioning of the entire system.
c. Conducting lux level measurement as per approved designs to the satisfaction of owner / purchaser.
d. Laying and termination of power and control cables for the equipment under the scope of this specification.

CIVIL WORKS

a. Civil works such as foundation for street lighting poles and lighting panel foundation and lighting transformer etc. shall be done by the bidder. The rates for these civil works shall be included in the erection rates of respective items.
b. Wherever cable is laid in buried trench, the excavation and filling shall be done by bidder free of cost.
c. All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grounding of anchor bolts, sills, inserts and fastening devices shall be carried out by the contractor including minor modification of civil works as may be required for erection.
d. Any cutting of masonry / concrete work, which is necessary shall be done by the contractor at his own cost and shall be made good to match the original work.
e. Wall openings at suitable locations for ventilation fans shall be made by the contractor. Civil works such as grouting, filling up of crevices/ cut outs etc during installation of equipment shall also be in contractor's scope. Any other damage caused to civil works during ETC work of the equipment/ system shall be made good to the original finish by the Contractor at no extra cost to the Purchaser.

3.9 BILL OF QUANTITY

Sl. No	Item	Unit	Qty
(A)	**OUTDOOR LIGHTING (switchyard and street lighting)**		
i)	**Lighting Panel**		
a)	**Lighting Panel (Outdoor) Type ACP-2**	Nos.	10
b)	**Lighting Panel (Outdoor) Type ACP-3**	Nos.	10
c)	**Sub lighting panel (outdoor) Type SLP**	Nos.	15
ii)	**Lighting fixtures and Receptacles** including junction box, lighting wires& flexible conduit (if required) from junction box to lighting fixture, mounting arrangement and other		

	accessories/materials etc. as required for complete installation and commissioning of lighting fixture.		
a)	Lighting Fixture **Type-SF1**	Nos.	50
b)	Lighting Fixture **Type-SF2**	Nos.	25
c)	Lighting Fixture **Type-SF4**	Nos.	8
d)	Lighting Fixture **Type-SF5**	Nos.	6
e)	Lighting Fixture **Type-S-LED**	Nos.	15
f)	Lighting Fixture **Type-SC**	Nos.	50
g)	63A, 415V : Interlocked switch socket outdoor Receptacle **(Type RP)**	Nos.	5
h)	15A, 240V: Outdoor Receptacle 2 pole, 3-pin type **(Type RO)**	Nos.	4
iii)	**Lighting Poles**		
a)	Solar based street lighting pole including solar panel as per technical specification	Nos.	15
b	Lighting Pole A1 type as per technical specification	Nos.	50
iv)	Cartwheel mounted aluminium ladder as per technical specification	No.	1
v)	Self supported aluminium ladder as per technical specification.	No.	1
vi)	Outdoor Power Receptacle for Oil Filtration Unit (250A)	No.	2
vii)	**Cabling**		
	1.1 kv grade XLPE/PVC Power Cables to be given by BHEL: (a) Laying in trench /tray/structure/wall i) 3.5 C x 300 sqmm (XLPE) ii)3.5 C x 70 sqmm (PVC) iii)3.5 C x 35 sqmm (PVC) iv) 4 C X 16 sqmm (PVC) v) 2 C X 6 sqmm (PVC) vi) 2CX2.5 sqmm (PVC) vii) 4C X 6 sqmm(PVC) (b) Laying in suitable size of GI/PVC pipe & buried i) 3.5 C x 300 sqmm (XLPE) ii) 3.5 C x 70 sqmm (PVC) iii) 3.5 C x 35 sqmm (PVC) iv) 4 C X 16 sqmm (PVC) v) 2 C X 6 sqmm (PVC) vi) 2CX2.5 sqmm (PVC) vii) 4C X 6 sqmm(PVC) (Supply of GI/PVC Pipe, cable glands (as acceptable to PGCIL) is deemed to be included in the scope of bidder)	 m m m m m m m m m m m m m m	 2000 11000 750 13600 1000 27000 1000 700 2800 250 3400 200 7000 200
(B)	**INDOOR LIGHTING* (Vendor Assessed Quantities) as per Technical specification For**		
1	Control Room cum Administrative Building	LS	1
2	Fire Fighting Pump House	LS	1
3	Switchyard Panel Room		
i)	765 kV (3 nos., 9mx3.9m each)	LS	1
ii)	400 kV (5 nos., 9mx3.9m each)	LS	1
iii)	400kV (1 No. 6mx3.9m each)	LS	1

4	1no. Car parking shed for 8 Cars	LS	1
(C)	**ILLUMINATION ERECTION MATERIAL**		
1	Aluminium Flat, GI Bolt with nut and washer for fixing indoor & outdoor lighting panels, GI Bolt with nut and washer for fixing control gear boxes, GI Bolt with nut ad washer for fixing outdoor JBs, GI Bolt with nut and washer for fixing outdoor lighting fixtures, GI Earthwire form JB to lighting fixtures, Mounting brackets for lighting fixtures for 2x400W/1x400W fixtures and all other accessories required for successful completion of project etc.	Lot	1

Notes:

1. **(*) a) Scope of work for Fire fighting & Air Conditioning System in Control room & Switchyard Panel Room to be done by Illumination contractor :**
Bidder shall supply and lay conduits in control room building & switchyard panel rooms for firefighting detection cables & Air conditioning system. Further, it shall be bidders' responsibility to supply and provide wiring & single supply points for AC units. Typical power supply distribution has been shown in drwg no. TB-1-376-510-007 (Single Line Diagram for LT AC & DC System). If any distribution panel is required for power distribution of AC units, the same is deemed to be included in bidders' scope. Tentative no. of 2 (/3) TR AC units: Control room (16nos) & Switchyard Panel Room (16nos). There shall be single supply point required for each 2 (/3) TR split AC inside control building.

b) Scope of work for telephone cables & telephone sets under PLCC package in Control room (Agra end) to be done by Illumination contractor :

Bidder shall supply and lay conduits in control room building for telephone cables & telephone sets under PLCC package. Further, it shall be bidders' responsibility to provide wiring for the following :

2 wire Telephone Set with connecting cables	Nos.	24
2 pair Telephone cables (Tinned Copper)	meter	500
4 wire telephone set with connecting cables	Nos.	6
5 Pair Telephone Cables, armoured ,0.5 sq. mm annealed copper conductor and petroleum jelly filled with polyethene outer jackets-Agra	meter	2500

2. BOQ furnished above is as per the preliminary estimate. Bidder shall submit detailed calculation for achieving the required lux levels & submit final BOQ for approval at contract stage.

3. The Bidder should quote the prices on unit rate basis for the Outdoor Switchyard package. In case of change in the requirements during detailed design after placement of order, additions/deletions to the scope shall be settled as per unit rates furnished in the Contract.

4. The Bidder should quote on lump sum basis for the indoor areas. There shall not be any change in price for indoor lighting during detailed design after placement of order.

5. After placement of order, the bidder has to design the system as per relevant standards/codes to the satisfaction of BHEL/PGCIL.

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4.0 TYPE TESTING

Bidder shall submit valid type test reports (as per relevant IEC/IS Standard) for approval. The type test reports submitted shall be of tests conducted within last 10 years prior to the date of bid opening i.e. 26.04.2014. The bidder should have conducted type test on identical or similar equipment/ components to those offered. In case type test reports are found to be technically unacceptable to BHEL/PGCIL, the type test shall be conducted without cost and delivery implication to BHEL.

5.0 QUALITY PLAN

Bidder to follow valid PGCIL approved Quality Plan as per PGCIL procedure. In case the bidder don't have PGCIL approved QP, it will be the bidder's responsibility to get its QP approved directly from the ultimate customer.

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ANNEXURE-1

List of Drawings:

Drwg. No.	Description
TB-0-376-316-002 (Sh.1)	Electrical Layout Plan and Sectional Elevation for 765/400kV Agra UPPTCL(NEW) S/S
TB-0376-316-002 (Sh.4)	Sectional Elevation for 765 kV Yard Agra UPPTCL(NEW) S/S (NEW)
TB-0-376-316-002 (Sh.5)	Sectional Elevation for 400 kV Yard Agra UPPTCL(NEW) S/S (NEW)
TB-0-376-316-002 (Sh.1)	Layout Plan of Trench for 765/400kV Agra UPPTCL(NEW) S/S (with area required to be Illuminated Marked)
TB-1-376-510-007	Single Line Diagram for LT AC & DC System
	Control Room Building Drawings
C-ENGG-NR-STD-CRB-ARCH-01(Sh.1 of 3)	Control Room Building Ground Floor Plan
C-ENGG-NR-STD-CRB-ARCH-01(Sh.2 of 3)	Control Room Building First Floor Plan
C-ENGG-NR-STD-CRB-ARCH-01(Sh.3 of 3)	Control Room Building Terrace Floor & Mumty Terrace Plan
C-ENGG-NR-STD-CRB-ARCH-02 (Sh.1 of 2)	Control Room Building Front & Rear Side Elevations
C-ENGG-NR-STD-CRB-ARCH-02 (Sh.2 of 2)	Control Room Building Left & Right Side Elevations
C-ENGG-NR-STD-CRB-ARCH-03 (Sh.2 of 2)	Control Room Building Doors & Windows Details
C-ENGG-NR-STD-CRB-ARCH-03 (Sh.2 of 2)	Control Room Building Doors & Windows Details
C-ENGG-NR-STD-CRB-ARCH-04 (Sh.1 of 1)	Control Room Building Finishing Drawing
C-ENGG-NR-STD-CRB-ARCH-05 (Sh.1 of 1)	Control Room Building Sections
	Fire Water Pump House
C/ENGG/STD/FFPH-1	Ground Floor Plan for Fire Water Pump House & Water Tank
C/ENGG/STD/FFPH-2	Elevation for Fire Water Pump House & Water Tank
	Switchyard Panel Room
C-ENGG-STD-PR-ARCH-3000	Standard Switchyard Panel Room Architectural Drawing of Panel Room

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Section - LS
LIGHTING SYSTEM

CONTENTS

Section - LS
LIGHTING SYSTEM

1.0 LIGHTING SYSTEM

1.1 LIGHTING SYSTEM FOR SUBSTATION

The scope of work comprises of design, engineering, testing, supply, installation, testing and commissioning of various lighting fixtures complete with lamps, supports and accessories, ceiling fans complete with electronic regulators, exhaust fans for toilets and pantry & accessories, lighting panels, lighting poles complete with distribution boxes, galvanized rigid steel /rigid PVC conduits, lighting wires, G.I. Earthwire, receptacles, tag block & telephone socket, switchboards, switches, junction boxes, pull out boxes complete with accessories, Bill of quantity for ***switchyard illumination for the bays under present scope*** is indicated in the bid proposal sheets (BPS) . Bidder shall quote unit rate against each item and payment shall be made as per final executed quantity.

Street lighting of switchyard shall be done by "Solar based energy efficient pole mounted lighting system" to achieve the desired lux level specified. Technical specifications of "Solar based energy efficient pole mounted lighting system" are attached at Annexure-III. The bidder shall quote unit rate for solar street lighting and the payment shall be made as per final executed quantity. In addition to Solar lighting, all street lighting shall also be connected with normal lighting system. A suitable changeover arrangement shall be provided in each street pole to switchover to normal lighting in case of prolonged outage of solar grid.

The entire control room building, fire fighting pump house lighting shall be done by LED based low power consumption luminaries to achieve desired lux level specified. The bidder shall quote on lumpsum basis on the basis of design criteria specified for each control room building and Fire Fighting pump house.

The lighting of conference room and control room in the control room building shall be powered by solar grid lighting arrangement. A changeover in the panel shall be provided to switchover on normal lighting in case of requirement. The execution of entire arrangement including design, solar grid interface with existing distribution, associated electrical panel, VRLA battery set, cabling etc shall be in the scope of the bidder.

1.1.1 SYSTEM DESCRIPTION

A typical arrangement of lighting system is shown in enclosed sketch no. C-ENG-GEN-LS .The lighting system shall comprise of the following:

1.1.2 AC Normal Lighting

AC lights will be connected to AC lighting panels. All the lights connected to the AC lighting system in different areas will be connected to the main lighting distribution boards.

1.1.2 AC Emergency Lighting

This system will be available in control room building, Fire fighting pump house , & switchyard. AC lighting load will be connected to this system which will be normally 'ON'. The lighting panels of this system will be connected to the Emergency lighting board which is fed from diesel generator during the emergency. 25% of lighting fixtures shall be connected on AC emergency lighting.

1.1.4 D.C. Emergency lighting

A few DC emergency lighting fixtures operated on the DC system will be provided in the strategic locations including staircase, corridors, electrical rooms, Battery charger room, LT switchgear room in control room building, and Fire fighting pump house so that the operating personnel can safely find their way even during emergency of a total AC failure. These lights will be normally 'OFF' and will be switched 'ON' automatically when under voltage occurs in the AC main lighting distribution board. GLS lamp down lighters in false ceiling area and Bulkhead fixtures in non false ceiling area to be used.

1.1.5 Exit Lightings

All Exit lightings in the buildings shall be fed by DC lighting panels. All necessary wiring and its termination shall be in the contractor's scope.

1.1.6 The lighting layout for and around Control Room Cum Administrative Office Building & Fire fighting Pump House indicating the type & BOQ for items shall be prepared and submitted by the contractor for owner's approval during detailed engineering.
The lux levels to be maintained shall be as per following:

Sl No	Area	Average Lux Level
1	***Control Room Building, Fire Fighting Pump house***	***SN. Area*** — ***Average Lux level at floor level*** ***i) Control Room & Conference room*** - ***350 Lux*** ***ii)Battery room, Passage, Pantry, Toilets, Corridors etc*** - ***100 Lux*** ***iii)All other rooms*** - ***200 Lux***

The minimum lux level to average lux level ratio should not be less than ***0.6*** (i.e Emin/Eav> ***0.6***). The maintenance factor for ***indoor*** illumination design shall be considered as ***0.8. The surface reflectance for ceiling/wall/floor shall be 50/30/10.***

The contractor shall submit detailed calculation for reaching the above Lux level ***for Employer's approval during detailed engineering.*** Contractor shall conform the Lux levels at different locations of the ***control room building and fire fighting pump house*** by measurement.

1.1.7 Ceiling fans (1400 mm sweep, AC 230 volts) shall be provided in , fire fighting pump house and non AC rooms in the control room building as per the requirements. Wall mounted fans shall be provided in the conference room, control room, shift manager and substation incharge rooms in control room building. Exhaust fans shall be provided in toilets and pantry.

1.1.8 One no. of aluminum ladder of each size shall be supplied by the contractor for maintenance purpose.

1.1.9 The following specific areas are included in the scope of lighting:

(i) Switchyard Area.
(ii) Switchyard Control Room cum Administrative Office Building
(iii) Fire fighting pump house
(iv) Street lighting (Street lighting shall be done using ***"Solar based energy efficient pole mounted lighting system"***)
v) DG area lighting
vi) LT Transformer area

1.1.10 For Outdoor Illumination

The switchyard and street lighting, detailed drawings showing the lighting layout and Electrical distribution diagram shall be prepared by the Contractor and submitted for approval. The above layout drawings will include disposition and location of lighting fixtures, receptacles, etc.

1.1.11 For Indoor Illumination

The conduit layout drawing for substation buildings based on the civil tender drawings, Electrical distribution diagram for substation buildings, & for substation yard etc. shall be prepared by the Contractor. All wiring including telephone wiring (tinned two pair copper) shall be in concealed conduit. Concealed MS junction boxes for sockets and light points shall be provided in all the rooms of Control Room cum Administrative Office Building and Fire Fighting pump house. In case where false ceiling surface conducting is permissible, all down run conduits will be concealed in wall below the false

ceiling.

1.1.12 Each cable run shall be tagged with number that appear in the cable schedules. Cables shall be tagged at their entrance and/or exit from any piece of equipment, junction or pull box, floor opening etc.

1.1.13 The tag shall be made up of aluminum with the number punched on it and securely attached to the cable by not less than two turns of G.I. wire. Cable tags shall be rectangular in shape for power cables and circular shape for control cables.

1.1.14 Location of cables laid directly under ground shall be indicated clearly by cable marker made of galvanised iron plate embedded in concrete block.

1.1.15 The location of under ground cable joints if any, shall be clearly indicated with cable marker with an additional inscription "cable joint".

1.1.16 The marker, which is a concrete block, shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change of direction. It shall also be located on both sides of the road or drain crossing.

1.2 LIGHTING SYSTEM FOR TOWNSHIP

1.2.1 The scope of work comprises of design, engineering, testing, supply, installation, testing and commissioning of 415 V, 400Amp, Main Township Distribution board/Energy meter Boards/Flat DBs etc as per single line diagram (C/ENGG/TS/STD/COMMON/01), Power and Control cables, various lighting fixtures complete with lamps, supports and accessories, ceiling fans complete with electronic regulators, exhaust fans for toilets and pantry & accessories, lighting panels, lighting poles complete with distribution boxes, galvanized rigid steel/PVC conduits, lighting wires, G.I. Earthwire, receptacles, tag block & telephone socket, bells, boxes for telephone/television & Air-conditioners points, switchboards, switches, junction boxes, pull out boxes complete with accessories as outlined in electrical drawings enclosed with tender documents for various type of quarters, parking, pump house, recreation centre and transit camp associated with township.

1.2.2 SYSTEM DESCRIPTION

The township lighting system shall comprise of the following:

1.2.3 EXTERNAL ELECTRIFICATION WORKS

The entire External Electrification work including connection to various quarters, recreation centres & transit camp associated with township including street

lighting of township shall be in the scope of the contractor. 415V,400A, Main Township distribution board shall be fed from 415V, 1000 A Main switchboard (being supplied under LT switchgear package) located in MCC room of main Switchyard through 2-3 ½ x300 sqmm XLPE insulated power cable from each source. Supply of MainTownship DB & associated 3 ½ x300 sqmm XLPE cable alongwith its interconnection, installation etc shall be in the scope of contractor.

Further typical distribution from 415 V Main Township DB is indicated in the drawings. The entire external electrification work comprising of feeder pillars, Cables and associated glands and lugs, steel tubular poles, street lights, MS junction boxes, GI pipes for cable protection, danger plates, Hume pipes, fire extinguishers, cable route markers etc as required shall be in the scope of the contractor.. The exact location of quarters ,recreation centre, transit camp, streets etc shall be intimated to successful bidder during detailed engineering. The bidder shall quote unit prices for items under external electrification work as per bill of quantity indicated in BPS for the estimated work.

1.2.4 INTERNAL ELECTRIFICATION WORKS

Standard electrical drawings for various type of quarters, recreation centre and transit camp associated with township is enclosed with tender documents. The entire work has to be performed in line with standard electrical layouts.

The scope shall broadly consist of entire concealed conduit work, wiring for lights/power/fans/telephones/cables & air-conditioners, supply and fixing of metal boxes, plates, switches, sockets, call bells, buzzers, exhaust fans, ceiling fans, MCBs, MCCBs, light fittings, energy meters boards & flat DBs etc as per the requirements of various quarters, recreation centres and transit camps.

In addition to above complete earthing (through separate earth pit) and lightning protection for each type of quarters ,recreation centre and transit camp shall be provided as per standard guidelines given in relevant Indian standards and code of practices. The complete drawing for earthing and lightning protection shall be submitted to owner for approval. The loop earthing inside the buildings shall be carried out with minimum 1Cx1.5 sqmm PVC stranded Copper wire . All materials required or earthing and lightning protection of township buildings shall be in the scope of contractor.

The bidder shall quote lumpsum prices for each type of quarters, recreation centre and transit camp separately in the BPS, including entire scope pertaining to lighting system, earthing and lightning protection. Any item not specifically outlined in the layouts and specifications enclosed herein shall necessarily be included by the contractor as per applicable buildings codes, statutory electricity rules and code of practices for the completion of scope.

2.0 DESCRIPTION OF ITEMS

2.1 DESCRIPTION OF ITEMS FOR SUBSTATION LIGHTING

The Contractor shall supply and install the following equipment and accessories in accordance with the specification.

2.1.1 LIGHTING PANELS

2.1.1.1 OUTDOOR

415 AC lighting panel with 415V, 63A, 3 phase 4 wire bus and one no. 63A, TPN, MCB with neutral unit as incomer and 20A, SP MCB as outgoing feeders, the details are as follows.

Type Of Panel	Description	Detail Of Outgoing Feeders
ACP 2	Outdoor	6 nos- 20 A single pole MCB and 3 No. 32 A Triple pole MCB with Neutral and suitable timer and contactor for automatic switching.
ACP 3	Outdoor Street lighting Panel	3 nos.-32A Triple pole MCB with Neutral with suitable timer and contactor for automatic switching

Note: The number of outgoing feeders indicated above are the minimum.

2.1.1.2 INDOOR

415 V indoor AC lighting panel ,63 A 3 phase 4 wire bus and one number 63 amp FP MCB with 300ma 63 A FP RCCB. Flush mounted with per phase isolation and LED indication lamps . The DB will be flush mounted and double door type.

Type Of Panel	Description	Detail Of Outgoing Feeders
ACP 1	Indoor	18 nos outgoing ,16 Amps SP MCB

220V DC indoor type change over board and 220V DC 32A two wire bus and one 32A contractor backed up by 32A double pole MCB as incomer. The panel shall have local push button controls. Following are the various types of panels required with control timer.

Type Of Panel	Description	Detail Of Outgoing Feeders
DCP	Indoor	6 nos outgoing ,16 Amps DP MCB

2.1.1.3 Sub-Lighting Panels

Type Of Panel	Description	Detail Of Outgoing Feeders
SLP	Outdoor	4 pole 32A Isolator suitable for 415V, 50 cycles AC supply, wlith LILO facility using 8 nos terminal blocks suitable for cable upto 16 mm sq cable Enclosure shall be suitable for outdoor use with IP-55 degree of protection as per IS:13947 (Part-1).

2.1.2 Lighting Fixtures

Please Refer Annexure-1

2.1.3 **RECEPTACLES**

Type Of Receptacle	Description	Detail Of Outgoing Feeders
RO	Outdoor	15A, 240V, Receptacle 2 pole, 3- pin type
RP	Outdoor	63A, 415V, Interlocked switch socket, receptacle
RI	Indoor	5/15A, 240V, Receptacle 3-pin type (Modular)

2.1.4 **SWITCH BOARDS**

Modular type switches, 5/15 Amp. Receptacles.

2.1.4 **CONDUITS AND ACCESSORIES**

Galvanised Rigid steel or Rigid PVC conduits of 20/25 /32 mm for Lighting and Telephone wiring

2.1.5 **JUNCTION BOXES** - with 5 Nos.of terminal blocks

2.1.6 **LIGHTING POLES** - (Type A1 poles & Type E1 poles)

2.1.7 FANS-1400 mm Sweep with Electronic regulator and 450 mm Wall Mounted fans

2.1.8 **MAINTENANCE EQUIPMENT**

i) A type Aluminium ladder of 3 mtr vertical height.
ii) Cartwheel mounted aluminium ladder Vertical Extendable from 5.1m to 11m.

2.1.9. **RECEPTACLES**

a) All receptacles shall be of cast steel/aluminium, heavy duty type, suitable for fixing on wall/column and complete with individual switch.

b) In general the receptacles to be installed are of the following types :

i) Type RO-15A, 240V, 2 pole, 3 pin type with third pin grounded, metal clad with gasket having cable gland entry suitable for 2Cx6 sq.mm. PVC/aluminium armoured cable and a metallic cover tied to it with a metallic chain and suitable for installation in moist location and or outdoor. The switch shall be of rotary type. Receptacles shall be housed in an enclosure made out of 2 mm thick Gl sheet with hinged doors with padlocking arrangements. Door shall be lined with good quality gasketing. This shall conform to IP-55.

ii) Type RI The 5/15 amp 6 pin receptacles with switches will be of Modular type with flush type switches and electroplated metal enclosures of approved make

iii) Type RP - 63A, 415V, 3 phase, 4 pin interlocked plug and switch with earthing contacts. Other requirements shall be same as type RO. The receptacle shall be suitable for 3.5C x 35/3.5Cx70 sq.mm. aluminium conductor cable entry and shall also be suitable for loop-in and loop out connection of cables of identical size. Receptacle shall be suitable for outdoor application. Receptacles shall be housed in a box made out of 2mm thick G.I. sheet, with hinged door with padlocking arrangement. Door shall be lined with good quality gasketing. This shall conform to IP-55.

2.1.10. **LIGHTING PANELS (L.P.)**

2.1.10.1 Each panel shall be provided with one incoming triple pole MCB with neutral link and outgoing miniature circuit breakers as per clause 2.0. The panels shall conform to IS-8623.

2.1.10.2 Constructional Features

a) Panels shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be of thickness not less than 2.00 mm (cold rolled) smoothly finished, levelled and free from flaws. Stiffners shall be provided wherever necessary. The indoor lighting panels will be ready made DB of minimum 1.6 mm sheet thickness .

b) The panels shall be of single front construction, front hinged and front connected, suitable for either floor mounting on channels, sills or on walls/columns by suitable M.S. brackets. Indoor panels in control room shall be flush mounted.

c) Panels shall have a dead front assembly provided with hinged door(s) and out door panels will be with padlocking arrangement with single key supplied in duplicate.

d) All out door panels, removable covers, doors and plates shall be gasket all around with neoprene gaskets.

e) The outdoor panels shall be suitable for cable/conduit entry from the top and bottom. Suitable removable cable gland-plate shall be provided on the top and bottom of panels. Necessary number of double compression cable gland shall be supplied, fitted on to this gland plate. The glands shall be screwed on top and made of tinned brass.

f) The panels shall be so constructed as to permit free access to connection of terminals and easy replacement of parts.

g) Each panel shall have a caution notice fixed on it.

h) Each panel will be provided with directory holder in which printed and laminated as built circuit directory would be kept inside a document holder/pasted at site.

i) Each Outdoor lighting panel shall be provided with one no. 'ON' indicating lamp for each phase alongwith fuses.For indoor lighting panels din mounted phase indication lamps will be provided , mounted along side of the MCB

j) Main Bus Bars

Bus bars shall be of aluminium alloy conforming to IS:5082 and shall have adequate cross-section to carry the rated continuous and withstand short circuit currents. Maximum operating temperature of the bus bars shall not exceed 85 deg. C. The bus bars shall be able to withstand a fault level of 9 kA for 1 sec. for AC panels and 4 KA for 1 sec. for DC panels.The Indoor lighting panels shall have copper bus bar

2.1.10.3 **JUNCTION BOXES**

a) The junction boxes shall be concealed type for indoor lighting and suitable for mounting on columns, lighting poles, structures etc., for outdoor lighting.

b) Junction boxes shall be of square/rectangular type of 1.6 mm sheet steel with minimum 6 mm thick pressure die cast aluminium material LM-6 and shall have bolted cover with good quality gasket lining.

c) The junction box and cover of sheet steel construction shall be hot dip galvanised.

d) The junction boxes shall be complete with conduit knockouts/threaded nuts and provided with terminal strips .The junction boxes shall be suitable for termination of Cable glands of dia 20 mm, 25 mm, 32 mm, 40 mm on all sides. The junction boxes shall be provided with 4 way terminals suitable for two numbers 10 sq. mm. wire & for street lighting/switchyard lighting suitable for 2 numbers 4C x 16 Sq.mm Al. cable.

e) The junction boxes shall have the following indelible markings
(i) Circuit Nos. on the top.
(ii) Circuit Nos. with ferrules (inside) as per drawings.
(iii) DANGER sign in case of 415 volt junction box.

f) The junction boxes shall be weather proof type with gaskets conforming to IP 55 as per IS:13947 (Part I) .

2.1.10.4 Occupancy Sensors:
Sufficient number of occupancy sensors shall be provided in the stairs area and corridors of control room cum administrative building. Each occupancy sensor shall be used for indoor use with time delay programmable in the minimum range of 1 sec. to 10 minutes to control the illumination in the area.

2.1.10.5 LED LUMINAIRES

Indicative models of LED luminaries are indicated in Annexure-I. The offered luminaries shall have minimum 50 lumens/watt capacity(ie ratio of total output lumens & input power) including driver. The quantity of these luminaries shall be decided on the basis of design criteria specified and lux level required at various rooms/locations. The bidder shall submit complete type test certificates & photometry reports of offered luminaries duly certified/conducted at accredited laboratory for owner's acceptance. The luminaries / drivers should generally comply with following relevant standards.

1) CISPR – 15/ EN 55015 (for RFI / EMI)

2) IEC 61347 – 2 – 13 (for safety)

3) IEC 62384 (for performance of controlgear)

4) IEC 61547 (for EMC immunity requirements)

5) IEC 61000- 3 -2 (for harmonics)

2.2 DESCRIPTION OF ITEMS FOR TOWNSHIP LIGHTING

2.2.1 415V, 400 Amp Main Township Distribution Board:-

400 Amp Main Township Distribution Board required for township lighting system shall conform to standard technical specification for LT switchgear, Sec-LT Switchgear annexed with bidding documents.. This distribution board shall have Incoming and Outgoing feeders as per feeder details indicated in the SLD (no: C/ENGG/TS/STD/COMMON/01) enclosed with bidding documents. 415V Main Township DB shall be sourced from the approved makes of Power Grid for LT Switchgear for substation packages.

2.2.2 Power and Control Cables:-

Power and Control cables required under township lighting shall conform to standard technical specification, Section-Power and Control cables annexed with bidding documents. Power and Control cables shall be sourced from approved makes of Power Grid for substation packages.

2.2.3 Earthing & Lightning Protection:-

Earthing and lightning protection system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, relevant Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.

a) Code of practice for Earthing IS: 3043
b) Code of practice for the protection of Building and allied structures against lightning IS: 2309.
c) Indian Electricity Rules 1956 with latest amendments.

2.2.4 Lighting Fixtures & Miscellaneous Items For Township Lighting:-

2.2.4.1 Lighting Fixtures:- Pl refer Annexure-I

2.2.4.2 Miscellaneous Items:- Pl refer Annexure-II

2.3 DESCRIPTION OF COMMON ITEMS FOR LIGHTING

2.3.1 LIGHTING FIXTURES AND ACCESSORIES

2.3.1.1 General

All lighting fixtures and accessories shall be designed for continuous operation under atmospheric conditions existing at site, without reduction in the life or without any deterioration of materials, internal wiring.

2.3.1.2 Temperature Rise

All lighting fixtures and accessories shall be designed to have a low temperature rise according to the relevant Indian Standards. The design ambient temperature shall be taken as 50 deg.C.

2.3.1.3 Supply Voltage

Lighting fixtures and accessories meant for 240V A.C. operation shall be suitable for operation on 240V A.C. 50Hz, supply voltage variation of ± 10%, frequency variation of ± 5% and combined voltage and frequency variation of ± 10%.

Lighting fixture and accessories meant for 220V DC operation shall be suitable for operation on 220V DC with variation between 190 to 240 Volts.

2.3.1.4 Lighting Fixtures

a) The lighting fixtures shall be Philips or Bajaj or Crompton Greaves make only except for ***LED luminaries*** for which make has been specified elsewhere in this section. The different types of lighting fixtures are also indicated elsewhere in this Section.

b) All fixtures shall be designed for minimum glare. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection.

c) All lighting fixtures shall be complete with fluorescent tubes / incandesent lamps/mercury vapour/sodium vapour lamps as specified and shall be suitably wired up.

d) All flourescent lamp fixture shall be complete with all accessories like ballasts, power factor improvement capacitors, lamps, starters, holders etc.

e) High beam fixtures shall be suitable for pendant mounting and flood lights shall have suitable base plate / frame for mounting on steel structural member. Hook mounted high beam fixtures are not acceptable.

f) Each lighting fixture shall be provided with an earthing terminal suitable for connection to 16 SWG GI earthing conductors.

g) All light reflecting surfaces shall have optimum light reflecting co-efficient such as to ensure the overall light output as specified by the manufacturer.

h) Height of fixtures should be such that it is easy to replace the lamps with normal ladder/stool. In case the ceiling height is very high, the fixtures may be placed on the walls for ground lighting.

2.3.1.5 ACCESSORIES

2.3.1.5.1 Lamp holders and Starter Holders

(a) Lamp holders/starter holders for fluorescent tubes shall be of the spring loaded, low contact resistance, bi-pin rotor type, resistant to wear and suitable for operation at the specified temperature, without deterioration in insulation value, contact resistance or retention of the lamp/starter. They shall hold the lamp/starter in position under normal condition of shock and vibration.

(b) Lamp holders/starter for incandescent lamps and HPMV/HPSV lamps shall be of screwed type, manufactured in accordance with relevant standard and designed to give long and satisfactory service.

2.3.1.5.2 **Ballasts**

a) All HPSV/HPMV/Metal halide lamp fixtures shall be provided with wire wound ballasts. All fluorescent fixtures shall be provided with high frequency electronic ballasts.The Ballasts shall be designed, manufactured and supplied in accordance with relevant standard and function satisfactorily under site condition specified. The ballasts shall be designed to have a long service life and low power loss.

b) Ballasts shall be mounted using self locking anti-vibration fixing and shall be easy to remove without dismantling the fixtures. They shall be totally enclosed units.

c) The wire-wound ballasts shall be of the inductive, heavy duty type, filled with thermosetting insulating moisture repellent polyester compound filled under pressure or vacuum. The ballast wiring shall be of copper wire. They shall be free from hum. Ballasts which produce humming sound shall be replaced free of cost by the Contractor. Ballasts for high pressure mercury vapour/ HPSV lamps shall be provided with suitable tappings to set the voltage within the range specified. End connections and taps shall be brought out in a suitable terminal block, rigidly fixed to the ballast enclosure.

d) Separate ballast for each lamp shall be provided in case of multi-lamp fixtures.

e) High frequency electronic ballasts shall be capable of satisfactory performance in adverse environment like that of EHV substation. Ballasts

shall consist of AC/DC converter, high frequency power oscillator and low pass filter. The ballasts shall be suitable for use of nominal voltage of 240V +/- 10%, 50 Hz supply. The filter circuit shall suppress the feedback of high frequency signals to the mains. The ballast shall be rated for 36/40W fluorescent fixtures. The ballasts shall confirm to IEC 68-2-6FC, IEC 929 for performance, IEC 928 for safety and EN 55015, EN 55022A for RFI and EN 61003.

2.3.1.5.3 Capacitors

a) The capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits.

b) Power factor of fluorescent lamp fixtures with HF electronic ballast shall not be less than 0.90 and that of High pressure Sodium Vapour, Mercury Vapour and Metal Halide lamp fixtures shall not be less than 0.85. The capacitors shall be suitable for operation at supply voltage as specified and shall have a value of capacitance so as to correct the power factors of its corresponding lamp circuit to the extent of 0.98 lag.

c) The capacitors shall be hermetically sealed in a metal enclosure.

2.3.1.5.4 **Lamps**

a) General Lighting Services (GLS) lamps shall be provided with screwed caps and shall be of 'clear' type unless otherwise specified.

b) The Bidder shall furnish typical wiring diagram for Fluorescent, HPMV & HPSV fitting including all accessories. The diagram shall include technical details of accessories i.e. starters, chokes, capacitors etc.

c) Flexible conduits if required, for any fixture shall be deemed to be included in Contractor's scope.

2.3.1.5.5 **SWITCH AND SWITCHBOARD**

(a) All Switch board/boxes, 5/15 Amp Receptacles and electronic fan regulators located in office/building areas shall be modular flush mounted type or brick wall with only the switch knob projecting outside.

(b) Switch boards/boxes shall have conduit knock outs on all the sides.

(c) The exact number of switches including regulator for fans and layout of the same in the switchboard shall be to suit the requirement during installation.

(d) The maximum number of luminaires ,controlled by one no 6 amp switch

would 4 nos. For DC fixtures there will be no switch and the same shall be directly controlled from DC LP

(e) The luminaires shall be wired in such a fashion that luminaires on each phase are evenly distributed all over the room.

2.3.1.5.6. **CONDUITS & CONDUIT ACCESSORIES**

a) The conduits shall conform to IS:9537 or IS 3419 as applicable. All steel conduits shall be seemed by welding, shall be of heavy gauge and shall be hot dip galvanised.

b) Flexible conduits wherever required shall be made with bright, cold rolled annealed and electro-galvanised mild steel strips or PVC/Plastic.

c) All conduits accessories shall conform to relevant IS and shall be hot dip galvanized or High quality virgin PVC and shall be ISI marked.

2.3.1.5.7 **TERMINAL BLOCKS**

Each terminal shall be suitable for terminating upto 2 Nos. 10 sq.mm. stranded Aluminium Conductors without any damage to the conductors or any looseness of connections. Terminal strips provided in street - lighting poles shall be suitable for terminating upto 2 nos. 4C x 16 sq. mm aluminium cables.

2.3.1.5.8 **PULL OUT BOXES**

a) The pull out boxes shall be concealed type for indoor lighting and suitable for mounting on column, structures etc., for outdoor lighting. The supply of bolts, nuts and screws required for the erection shall be included in the installation rates.

b) The pull out boxes shall be circular of cast iron or 16 SWG sheet steel and shall have cover with good quality gasket lining.

c) The pull out boxes and cover shall be hot dip galvanised.

d) The pull out boxes shall be completed with conduit knock outs/threaded hubs and provided at approximately 3 meters intervals in a conduit run.

2.3.1.5.9 Residual Current Circuit Breakerss (RCCB)

For indoor panels 63A 4pole 300 ma RCCB conforming IS 12640 will be provided along with incomer

2.3.1.5.10 Miniature Circuit Breaker (MCB)

a) The miniature circuit breakers shall be suitable for manual closing, opening, automatic tripping under overload and short circuit. The MCBs shall also be trip free. MCB of Type C tripping characterstics as per IS 8828 will be used for Switchyard lighting.

b) Single pole as well as three pole versions shall be furnished as required in the Schedule of Lighting Panels.

c) The MCBs and panel MCCB together shall be rated for full fault level. In case the MCB rating is less than the specified fault level the bidder shall co-ordinate these breaker characteristics with the back up MCCB in such a way that if fault current is higher than breaker rating, the MCCB should blow earlier than the breaker. If the fault current is less than MCB breaking capacity, MCB shall operate first and not the incomer MCCB.

d) The MCBs shall be suitable for housing in the lighting panels and shall be suitable for connection with stranded copper wire connection at both the incoming and outgoing side by copper lugs or for bus bar connection on the incoming side.

e) The terminals of the MCBs and the 'open' 'close' and 'trip' conditions shall be clearly and indelibly marked.

f) The tenderer shall check and co-ordinate the ratings of MCBs with respect to starting characteristics of discharge lamps. The vendor has to furnish overload and short circuit curve of MCB as well as starting characteristics curves of lamps for Employer's approval.

g) The MCB shall generally conform to IS:8828.

2.3.1.5.11 Contactors

Contactors shall be of the full voltage, direct-on line air break, single throw, electro-magnetic type. They shall be provided with atleast 2-'NC' and 2'NO' auxiliary contacts. Contactor shall be provided with the three element, positive acting, ambient temperature compensated time lagged, hand reset type thermal overload relay with adjustable settings to suit the rated current. Hand reset button shall be flush with the front of the cabinet and suitable for resetting with starter compartment door closed. The Contactor shall be suitable for switching on Tungsten filament lamp also. The bidder shall check the adequacy of the Contactors rating wire with respect to lighting load.

2.3.1.5.12 Push Buttons

All push buttons shall be of push to actuate type having 2 'NO' and 2 'NC' self

reset contacts. They shall be provided with integral escutcheon plates engraved with their functions. Push buttons shall be of reputed make.

2.3.1.5.13 Labels

a) The lighting panels shall be provided on the front with panel designation labels on a 3 mm thick plastic plate of approved type. The letter shall be black engraved on white back ground.

b) All incoming and outgoing circuits shall be provided with labels. Labels shall be made of non-rusting metal or 3 ply lamicold. Labels shall have white letters on black or dark blue background.

2.3.1.5.14 Earthing Terminals

Panels shall be provided with two separate and distinct earthing terminals suitable to receive the earthing conductors of size 50x6 G.S. Flat.

2.3.1.5.15 Type test reports for following tests on all lighting panels shall be submitted for approval as per clause 9.2 of section : GTR.

(i) Wiring continuity test
(ii) High voltage (2.5 KV for 1 minute) and insulation test
(iii) Operational test
(iv) Degree of protection (not less than IP-55 test on outdoor Lighting Panels and IP-52 test on indoor Lighting Panels as per IS 13947 (part I))
(v) Heat run test

2.3.1.5.16. **LIGHTING POLES**

a) The Contractor shall supply, store and install the following types of steel tubular lighting poles required for street lighting.

i) Type A1 Street Lighting Pole - for one fixture

ii) Type E1 Post top lantern pole - for one fixture

b) Street/flood light poles shall conform to the enclosed drawings. In front of control room building , and Fire Fighting Buildings, decorative post top lantern (Type E1) poles and Bollards shall be installed.

c) Lighting poles shall be complete with fixing brackets and junction boxes. Junction boxes should be mounted one meter above ground level.

d) The lighting poles shall be coated with bituminous preservating paint on the inside as well as on the embedded outside surface. Exposed outside surface shall

be coated with two coats of metal primer (comprising of red oxide and zinc chromate in a synthetic medium).

e) The galvanised sheet steel junction box for the street lighting poles shall be completely weather proof conforming to IP-55 and provided with a lockable door and HRC fuse mounted on a fuse carrier and fuse base assembly. The fuses & junction box shall be as specified in the specification. However, terminals shall be stud type and suitable for 2 nos. 16 sq.mm. cable.

f) Wiring from junction box at the bottom of the pole to the fixture at the top of the pole shall be done through 2.5 sq. mm wire.

g) Distance of centre of pole from street edge should be approximately 1000 to 1200 mm.

h) Earthing of the poles should be connected to the switchyard main earth mat wherever it is available and the same should be earthed through 3M long, 20 mm dia, earth electrode.

2.3.1.5.17 CEILING & WALL MOUNTED FANS AND REGULATORS

a) The contractor shall supply and install 1400 mm sweep ceiling fans complete with electronic regulator and switch, suspension rod, canopy and accessories.The wall mounted fans shall be of 400 mm sweep

b) The contractor shall supply and install the switch, electronic regulator and board for mounting switch and electronic regulator for celling fans. The regulator will be housed in common switchboard for lighting and shall be of similar make and model as that of modular switches.

c) Winding of the fans and regulators shall be insulated with Class-E insulating material. Winding shall be of copper wire.

d) Electronic regulator with stepped control shall be provided.

e) Ceiling Fans and Wall mounted Fans shall be of Alstom / Crompton Greaves / Bajaj Electricals / Usha Electricals make.

2.3.1.5.18 LIGHTING WIRES

a) The wiring used for lighting shall be standard products of reputed manufacturers.

b) The wires shall be of 1100 V grade, PVC insulated product of reputed manufacturers.

c) The conductor sizes for wires used for point wiring beyond lighting panels shall

be 2.5 sq.mm, 4 sq.mm, 6 sq.mm and 1.5 sq.mm stranded copper wire.

d) The wires used for connection of a lighting fixture from a nearest junction box or for loop-in loop-out connection between two fluorescent fixtures shall be single core copper stranded conductor, 1100V grade flexible PVC insulated cords, unsheathed, conforming to IS:694 with nominal conductor cross sectional areas of 2.5 sq. mm.

e) The wires shall be colour coded as follows:

Red for R - Phase
Yellow for Y - Phase
Blue for B - Phase
Black for Neutral
White for DC (Positive)
Grey for DC (Negative)

2.3.1.5.19 LIGHTING SYSTEM INSTALLATION WORKS

2.3.1.5.19.1 General

In accordance with the specified installation instructions as shown on manufacturer's drawings or as directed by Employer, Contractor shall unload, erect, install, test and put into commercial use all the electrical equipment included in the contract. Equipment shall be installed in a neat, workmanship manner so that it is level, plumb square and properly aligned and oriented. Tolerances shall be as established in manufacturers drawing or as stipulated by Purchaser.

All apparatus, connections and cabling shall be designed so as to minimise risk of fire or any damage which will be caused in the event of fire.

2.3.1.5.19.2 Conduit System

a) Contractor shall supply, store and install conduits required for the lighting installation as specified. All accessories/fittings required for making the installation complete, including but not limited to pull out boxes (as specified in specification ordinary and inspection tees and elbow, checknuts, male and female bushings (brass or galvanised steel), caps, square headed make plugs, nipples, gland sealing fittings, pull boxes, conduits terminal boxes, glands, gaskets and box covers, saddle terminal boxes, and all steel supporting work shall be supplied by the Contractor. The conduit fittings shall be of the same material as conduits. The contractor shall also supply 20 mm mm PVC conduit and accessories for telephone wiring.

b) All unarmoured cables/wires shall run within the conduits from lighting panels to

lighting fixtures, receptacles. etc.

c) Size of conduit shall be suitably selected by the Contractor.

d) Conduit support shall be provided at an interval of 750 mm for horizontal runs and 1000 mm for vertical runs.

e) Conduit supports shall be clamped on the approved type spacer plates or brackets by saddles or U-bolts. The spacer plates or brackets in turn, shall be securely fixed to the building steel by welding and to concrete or brick work by grouting or by nylon rawl plugs. Wooden plug inserted in the masonary or concrete for conduit support is not acceptable.

f) Where conduits are along with cable trays they shall be clamped to supporting steel at an interval of 600 mm.

g) For directly embedding in soil, the conduits shall be coated with an asphalt-base compound. Concrete pier or anchor shall be provided wherever necessary to support the conduit rigidly and to hold it in place.

h) For long conduit run, pull boxes shall be provided at suitable intervals to facilitate wiring.

i) Conduit shall be securely fastened to junction boxes or cabinets, each with a lock nut inside and outside the box.

j) Conduits joints and connections shall be made through water-tight and rust proof by application of a thread compound which insulates the joints. White lead is suitable for application on embedded conduit and red lead for exposed conduit.

k) The entire metallic/PVC conduit system, shall be embedded, electrically continuous and thoroughly grounded. Where slip joints are used, suitable bounding shall be provided around the joint to ensure a continuous ground circuit.

l) Conduits and fittings shall be properly protected during construction period against mechanical injury. Conduit ends shall be plugged or capped to prevent entry of foreign material.

2.3.1.5.19.3 Wiring

a) Wiring shall be generally carried out by PVC insulated wires in conduits. All wires in a conduit shall be drawn simultaneously. No subsequent drawings of wires is permissible.

b) Wires shall not be pulled through more than two equivalent 90 deg. bends in a single conduit run. Where required, suitable junction boxes shall be used.

c) Wiring shall be spliced only at junction boxes with approved type terminal strip.

d) For lighting fixtures, connection shall be teed off through suitable round conduit or junction box, so that the connection can be attended without taking down the fixture.

e) For vertical run of wires in conduit, wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/junction box.

f) Maximum two wires can be terminated to each way of terminal connections.

g) Separate neutral wires are to be provided for each circuit.

h) AC and DC wiring should not run through the same conduit.

2.3.1.5.19.4 Lighting Panels

a) The lighting panels shall be erected at the locations to be finalised during detailed engineering.

b) Suitable foundations/supporting structures for all outdoor type lighting panels shall be provided by the Contractor.

2.3.1.5.19.5 Foundation & civil works

a) Foundation for street lighting poles, panel foundation and transformer foundation shall be done by the Contractor..

b) All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grouting of anchor bolts, sills, inserts and flastening devices shall be carried out by the Contractor including minor modification of civil works as may be required for erection.

c) Any cutting of masonary / concrete work, which is necessary shall be done by the Contractor at his own cost and shall be made good to match the original work.

ANNEXURE-1

SI. No.	Type of Lighting Fixture	Description	Philips Catalogue No	CGL Catalogue No	Bajaj Catalogue No
1	F1	2x28W T5 type fluorescent lamps in industrial reflector type fixture, complete with accessories and suitable for pendent /surface mounting.	TMS 122/228 HF	T5GP228EB	BTIR 228
2	FF	2x28 T5 energy efficient fluorescent lamps with low glare, mirror optics suitable for recess mounting type lighting fixture.	TBS 088/228 C5 HF	TSCQ12228EB	BTMRA 228 MATT
3	FL	2x28W T5 energy efficient fluorescent lamps with low glare mirror optics suitable for pendent/surface mounting with all accessories	TCS 398/228 D6 HF	----------	BTSMU 228 MSS
4	TL	Sleek and Functional electronic decobatten suitable for use with 1x'TLD'36W fluorescent lamp with dual tone end caps. Pre-phosphated & powder coated CRCA steel channel complete with all electrical accessories like electronic ballast, lamp holders all prewired up to a terminal block	TMS500/136 HF	DMLU14EB	BC1R136WEB

5	IB	60/100w GLS lamp in Bulkhead fixtures with Cast Aluminium alloy body, suitable for column, wall,and ceiling mounting finished stove enameled silver grey outside	NXC101	IBH1110/BC	BJDB100BC
6	BL	Aesthetic wall/ceiling mounted luminaire suitable for 1x PL-C 13W OR 11W CFL. Low loss O.C. Copper ballast.Built in high gloss anodized reflector. Twin finish UV stabilised SAN diffuser for protection & elimination of lamp glare.	FMC21/113	TLN11	BJC111
7	SL	Aesthetic ceiling mounted luminaire for Ecotone crystal/Décor CFL of 2x9W or 1x18W. ABS housing pre-wired with porcelain lampholder. Pre-phospated plated CRCA gear tray.	FL343/118	CBHE29	---------- -
8	BH	Bulkhead luminaire suitable for use with PL-S 9W CFL. Single piece pressure die-cast aluminium & cover retaining Frame. Opal acrylic cover along with a gasket made of E.P.R..	FXC 101/109	ICBH10	BJBE19
9	BLD	2X9 Or 1x18 watt CFL bollard light for landscape lighting having FRP/LLDPE housing	FGC202 /118	CFBL1229	BJBOL 03 29 CFL

10	DLR	2x18 watt CFL Downlighter with HF ballast suitable for recess mounting	FBH145/218L HF	DDLH218TG	BJDR 65C 218 DL
11	DSM	1X13 WATT surface mounted CFL	FCS100/113	----------	BJDS110/113C WEB
12	IF	Incandescent GLS lamp down light	DN622	DDLV10BC	BJDR 100W
13	SF1	1 X 400W HPSV lamps in high flood lighting fixture with integral control gear	SWF 330/1X400	FAI40IH	BJFL 400SV TS
14	SF2	2 X 400W HP sodium Vapour lamps in high flood lighting, non-integral control gear:	RVP302/2x400W	FHD1424	BJENF 22
15	SF3	1 X 250W HPSV lamps in high flood lighting fixture with integral control gear:	SWF 330/1X250	FAI1125IH	BJFL 250 SV TS
16	SF4	150W HP Metal halide MHN-TD lamp in flood lighting fixture with integral control gear.	SWF230/150 MHN-TD	FAD1215IH/MH	BGEMF150MH DE
17	SF5	125 HP MV Lamp in weather proof post top lantern for mounting on pole top	HPC-101/125 HPF	MPT1112IL/BM/ES	BJDPTI 125 MV
18	SC	150W SON-T Tubular Sodium Vapour lamp in street lighting luminaire with toughned glass cover.	SRX-51/150	SSG2315IH.	BGEST 150 SV

19	*LED LUMINAIRES*			
	Type	*Description*	*Phillips*	*Insta Power*
a)	*I-LED1*	*2x2, luminaries with high efficacy and low power consumption suitable for general office lighting , conference room and cabins applications.*	*QUADRA LED BCS705 20xLXML/NW PSU-E-220-240V* *BBS705 20xLXML/NW PSU-E-220-240V* *BBS 805 2xLLM1800/840 PSU-E 220-240V*	*INSTA PRISMA 45W/OMEGA 45W*
b)	*I-LED2*	*19W, Recessed type LED luminaries with high efficacy and low power consumption for passages, corridor and toilet areas.*	*LUX SPACE BBS480 1XDLED-4000 PSU-E 220-240V WH*	*INSTA DL12W-6SH*
c)	*S-LED*	*Street lighting luminaries*	*BETA Power BRP320 1x24LED-HP/CW PSU GR*	*VERSAT-2-48*

ANNEXURE-II

Sl No	Item	Abbreviation	Item Description	Make(s)
1	TELEPHONE BOX/TELEVISION BOX	TB	Termination box for Television and Telephone	Approved makes
2	FLAT DB TYPE A	DB	240V Indoor AC Distribution board, 63A or 32A, DP RCCB as Incomer with 12 Nos. 16A SP MCBs as outgoing. DB shall be flush mounted type.	Legrand/Hagger
3	METER DB TYPE-A & TYPE-B	MB	For feeder details, please refer drg no.- C/ENGG/TS/STD/COMMON/SLD/01	Approved makes
4	SWITCHBOARD WITHOUT 6A SOCKET	SBA	MODULAR SWITCHBOARD WITH 5A SWITCHES AS REQUIRED	Anchor/Crabtree
5	TWO WAY SWITCHBOARD FOR STAIRS	SBB	MODULAR SWITCHBOARD WITH 5A TWO WAY SWITCH	Anchor/Crabtree
6	SWITCHBOARD WITH 6A SOCKET	SBC	MODULAR SWITCHBOARD WITH 1 No. Socket and 5A SWITCHES AS REQUIRED	Anchor/Crabtree
7	TELEPHONE POINT	TP	Modular Socket	Anchor/Crabtree
8	TELEVISION POINT	TV	Modular Socket	Anchor/Crabtree
9	AIRCONDITIONER POINT WITH 15A SWITCH	RAC	Socket with Switch Metal clad Type	Anchor/Crabtree
10	15A POWER POINT WITH 15A SWITCH	RB	Modular Socket with Switch	Anchor/Crabtree
11	5A POWER POINT WITH 5A SWITCH	RA	Modular Socket with Switch	Anchor/Crabtree
12	CHANDELIER	CH	Decorative fixture with 1 X 60 W GLS Lamp	Any Reputed Make
13	BELL PUSH	BP	Modular Type	Anchor/Crabtree
14	BELL	BELL	Call Bell	Anchor/Crabtree
15	EXHAUST FAN	EFC	300 mm sweep Trans'Air	CGL/Bajaj/Usha
16	CEILING FAN	CFC	1200 mm sweep with electronic regulator	CGL/Bajaj/Usha

Annexure-III

Solar Based Energy Efficient Pole Mouted Street Lighting System

I. SCOPE

A stand alone solar based energy efficient pole mounted street lighting system comprising of galvanized steel tubular pole, LED type light source, lead acid tubular type maintenance free battery, photovoltaic (PV) module (s), control electronics, inter-connecting wires / cables, Module mounting hardware, Battery box, any other item for safe and trouble free operation etc shall be provided with each unit.

II. DUTY CYCLE

The system should be designed to automatically switch ON at dusk. operate through out the night and automatically switch OFF at the dawn under average daily insolation of 5.5 kWh /sq.m. on a horizontal surface.

III. LIGHT SOURCE

i. ***The light source shall be of white LED type, single lamp or multiple lamps can be used. View angles shall be of wider range with a minimum of 120 degre and above above. The luminous performance of LEDs used should not be less than 50 lumen/watt including driver. LEDs which emit ultraviolet light is not acceptable.***

ii. ***The light output from the white LED light source should be constant through out the duty cycle.***

iii. ***The lamps should be housed in an assembly suitable for outdoor use. The make, model number, country of origin and technical characteristics of white LEDs used in the lighting system must be furnished.***

IV. BATTERY

i. ***The battery shall be of maintenance free lead acid tubular type.***

ii. ***The battery will have a minimum rating of 12V, 75 Ah (at C/10) discharge rate.***

iii. ***75 % of the rated capacity of the battery should be between fully charged & load cut off conditions.***

V. ELECTRONICS

i. ***The inverter should be of quasi sine wave/sine wave type. with frequency in the range of 20 - 35 KHz. Half-wave operation is not acceptable.***

ii. ***The total electronic efficiency should be at least 80 %.***

iii. ***No blackening or reduction in the lumen output by more than 10% should be observed after 1000 ON/OFF cycles (two minutes ON followed by four minutes OFF is one cycle)***

iv. ***The idle current consumption should not be more than 10 mA***

v. ***Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery through out the year.***

vi. ***Necessary lengths of wires/cables and fuses should be provided. Wires and cables shall be of approved make and shall be BIS marked.***

vii. ***The PV module will be used to sense the ambient light level for switching ON and OFF the lamp.***

VI. PV MODULE (S)

i. ***The PV module(s) shall contain single or multi crystalline silicon solar cells. Test reports for solar cells being offered shall be duly conducted at accredited laboratory. The module must be manufactured by a company, which has obtained a valid test certificate for module qualification as per prevailing IEC or BIS standards for any of the modules manufactured by that company. A copy of the test certificate must be submitted for owner's acceptance. The power output of the module(s) under STC should be a minimum of 74 W Either two module; of minimum 37 W output each or one module of 74 W output should be used.***

ii. ***The operating voltage corresponding to the power output mentioned above should be 16.4 V.***

iii. ***The open circuit voltage of the PV modules under STC should be at least 21.0 Volts.***

iv. ***The terminal box on the module should have a provision for opening for replacing the cable if required***

v. ***A strip containing the following details should be laminated inside the module so as to be clearly visible from the front side.***
a) Name of the Manufacturer or distinctive Logo
b) Model or type No
c) Serial No & year of manufacturing.

VII. ELECTRONIC PROTECTIONS

i. ***Adequate protection is to be incorporated under no -load conditions e.g when the lamp is removed and the system is switched ON.***

ii. ***The system should have protection against battery overcharge and deep discharge conditions.***

iii. ***Fuses should be provided to protect against short circuit conditions.***

iv. ***A blocking diode should be provided as part of the electronics, to prevent reverse flow of current through the PV module(s), in case such a diode is not provided with the solar module (s)***

v. *Full protection against open circuit accidental short circuit and reverse polarity should e provided.*

vi. *The light output should remain constant with variations in the battery voltages.*

VIII. MECHANICAL HARDWARE

i. *A metallic frame structure (with corrosion resistance paint) to be fixed on the pole to hold the SPV module(s) The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that the module(s) can be oriented at the specified tilt angle*

ii. *The pole should be made of mild steel pipe with a height of 4 metres above the ground level, after grouting and final installation. The pole should have the provision to hold the we proof lamp housing It should be painted with a corrosion resistant paint.*

iii. *A vented, acid proof and corrosion resistant painted metallic box for outdoor use should be provided for housing the battery.*

IX. OTHER FEATURES

I. *The system should be provided with 2 LED indicators a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery. The green LED should glow only when the battery is actually being charged*

II. *There will be a Name Plate on the system which will give*
a) Name of the Manufacturer or Distinctive Logo
b) Serial Number & year of manufacture

III. *Components and parts used in the solar street lighting systems should conform to the latest BIS specifications, wherever such specifications are available and applicable.*

IV. *The PV module(s) will be warranted for a minimum period of 10 years from the date of supply and the street lighting system (including the battery) will be warranted for a period of two years from the date of supply. The Warranty Card to be supplied with the system must contain the details of the system supplied. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.*

V. *An Operation Instruction and Maintenance Manual , in English and the local language should be provided with the solar street lighting system.*

The following minimum details must be provided in the Manual

a. *About Photovoltaics*

b. *About solar street lighting system - its components and expected performance*

c. *About PV module*

d. *About CFL*

e. ***About battery.***

f. ***Clear instructions about erection of pole and mounting of PV module and lamp housing assembly on the pole.***

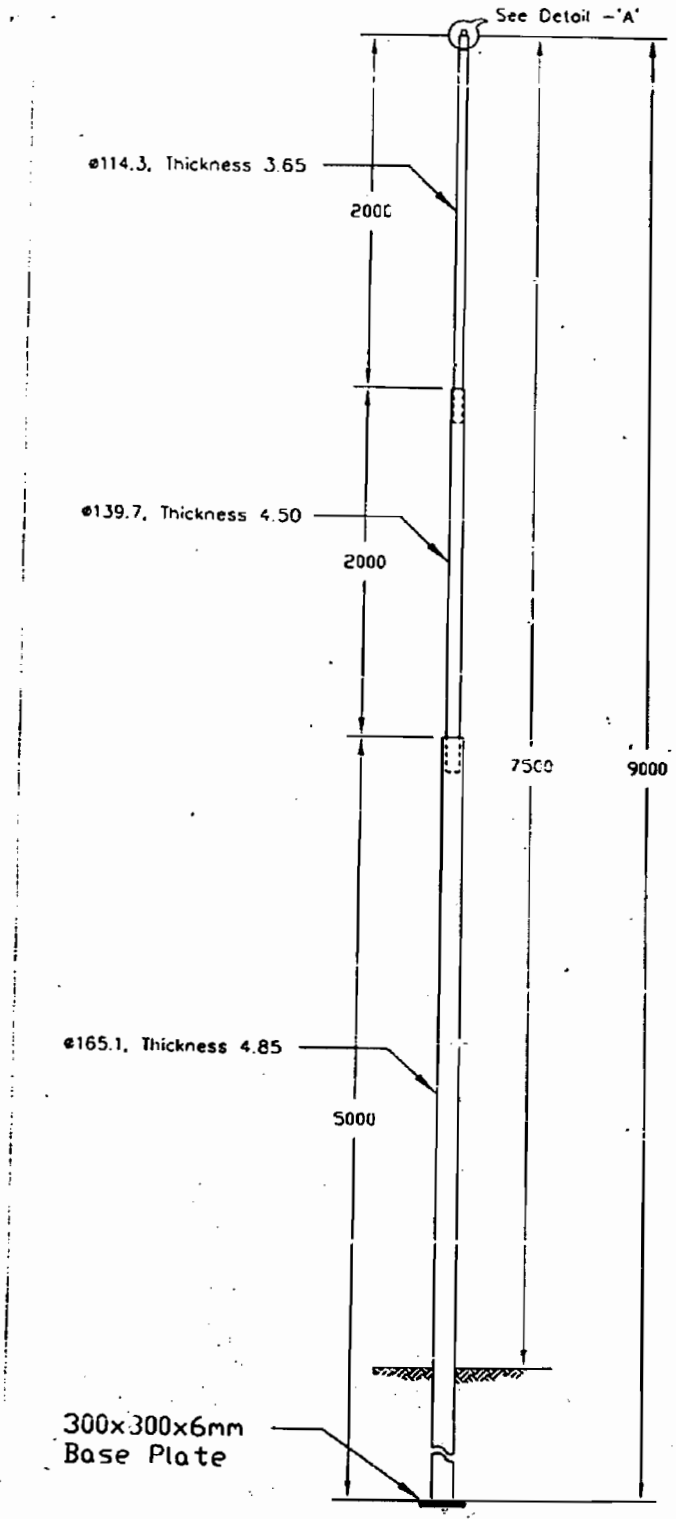
g. ***About electronics.***

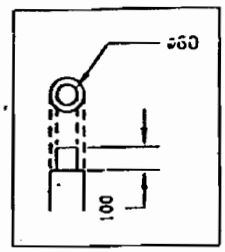
h. ***About charging and significance of indicators***

i. ***DO's and DON'T's,***

j. ***Clear instructions on regular maintenance and trouble shooting of the solar street lighting system.***

k. ***Name and address of the contact person in case of non-functionality of the solar street lighting system.***





Detail –'A'

LUMINAIRE MOUNTING PROVISION

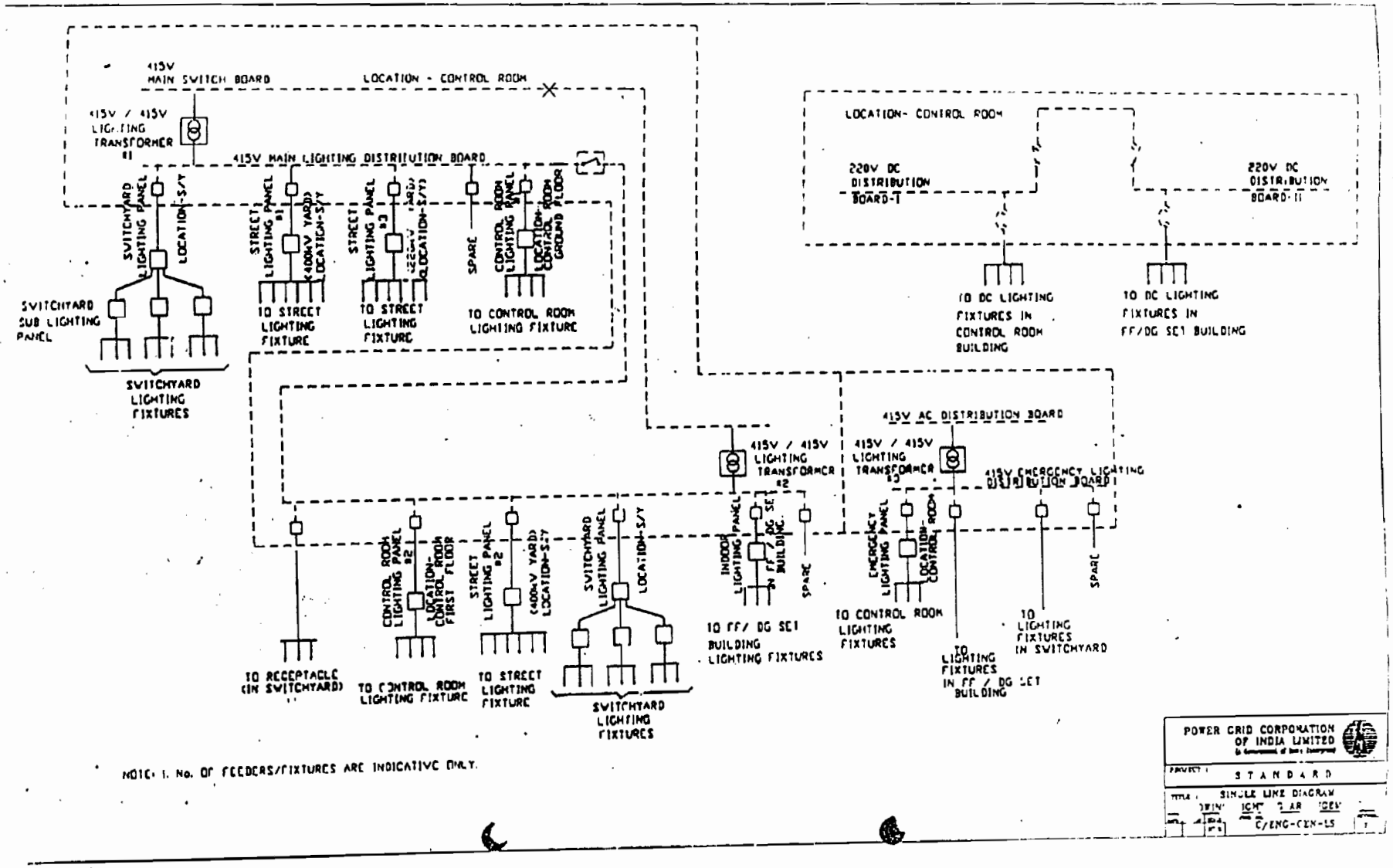
NOTES

1. WELDED STEEL TUBULAR POLE 410 SP32 AS PER IS 2713 (PART II)–1980.
2. EXPOSED OUTSIDE SURFACE SHALL BE COATED WITH TWO COATS OF RED OXIDE PRIMER (Zinc chromate in a synthetic medium)
3. EMBEDDED PORTION WILL BE COATED WITH BITMUNIOUS PRESERVATIVE.
4. POLE IS MANUFACTURED FROM STEEL PIPES \CONFORMING TO IS 1161 –1979
5. ALL DIMENSIONS ARE IN MM
6. TOLERANCES AS PER IS 2713 AND IS 1161
7. TWO COATS OF LIGHT BISCUIT SYNTHETIC ENAMEL.

G.A. DRAWING FOR STEEL TUBULAR POLE 9 MTRS HEIGHT. (TYPE A1)

POWER GRID CORPORATION OF (I) LTD.

NEW DELHI



NOTE: 1. No. OF FEEDERS/FIXTURES ARE INDICATIVE ONLY.

SECTION –2

GENERAL TECHNICAL REQUIREMENTS

2.0 GENERAL :

2.0.1 The lighting System design shall comply with acceptable norms and the best engineering practices. The lighting shall be designed to provide uniform illumination with minimum glare. The lighting system shall meet all the statutory requirements, local rules etc.

2.0.2 Feeders required for lighting shall be given from Main LVAC /DC boards. Further distribution using lighting DB's panels for Illumination shall be in Illumination contractor scope .Laying & termination of cables from LVAC /DC boards onwards shall be in illumination contractor scope.

2.0.3 APPLICABLE CODES AND STANDRADS

All material / work shall conform to the following standards & codes unless otherwise stated. All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments & revisions as on date of bid opening. In case of conflict between this specification and those (codes, standards etc) referred to herein, the former shall prevail.

(i)	IS:1913	General and safety requirements for electric light fittings
(ii)	IS:418	Tungsten filament lamp for domestic and similar general lighting purposes
(iii)	IS:10322	Luminaires
(iv)	IS:10276	Edison Screw lamp holders
(v)	IS:2418	Tubular fluorescent lamps
(vi)	IS:9974	High pressure sodium Vapour lamps
(vii)	IS:9900	High Pressure mercury vapour lamps.
(viii)	IS:6616	Ballasts for high pressure mercury Vapour lamps
(ix)	IS:1258	Specification for bayonet lamp holders
(x)	IS:3323	Bi-pin lamp holders for tubular fluorescent lamps
(xi)	IS:13021	AC Supplied electronic ballasts for tubular fluorescent lamps
(xii)	IS:1534	Ballasts for use in fluorescent lighting fittings
(xiii)	IS:1569	Capacitors for use in tubular fluorescent high pressure mercury vapour and low pressure sodium Vapour discharge lamp circuit.
(xiv)	IS:2215	Starters for fluorescent lamps
(xv)	IS:3324	Holders for starters for tubular fluorescent lamps
(xvi)	IS:418	GLS lamps
(xvii)	IS:13021	AC supplied electronic ballasts for tubular fluorescent lamps
(xviii)	IS:2713	Tubular steel poles
(xix)	IS:280	MS Wire for general Engg. Purpose.

2.0.4.1 Conduits, Pipes and Accessories

(I)	IS:9537	Rigid Steel conduit for electrical wiring
(ii)	IS:3480	Flexible steel conduits for electrical wiring
(iii)	IS:2667	Fitting for rigid steel conduits for electrical wiring
(iv)	IS:3837	Accessories for rigid steel conduits for electrical wiring.
(v)	IS:4649	Adaptors for flexible steel conduits

2.0.4.2 Lighting panels, Switch boxes, receptacles and junction boxes.

(i)	IS:13947	Specification for LV switchgear and control gear (Parts 1to 5)
(ii)	IS:8828	Circuit breakers for over current protection for house hold and similar installations.
(iii)	IS:5	Colours for ready mixed paints and enamels
(iv)	IS:2551	Danger notice plates
(v)	IS:5133	Steel and cast iron boxes
(vi)	IS:2629	Recommend practice for hot dip galvanizing of iron & steel.
(vii)	IS:3854	Switches for domestic and similar purposes
(viii)	IS:6875	Control switches (Switching devices for Control and auxiliary Circuits including contactor relays) for Voltages upto and including 1000V AC and 1200V DC.
(ix)	IS:13703	Low voltage fuses for voltages not exceeding 1000V AC or 1500V DC
(x)	IS:9224	HRC Cartridge fuse links for voltage above 650V(Part2)
(xi)	IS:5082	Wrought aluminum and Al. alloys, bars, rods, tubes and section for electrical purposes.
(xii)	IS:8623	Factory built assemblies of switchgear and control gear for voltages upto and including 1000 V AC and 1200V DC.
(xiii)	IS:1248	Direct acting electrical indicating instruments .
(xiv)	IS:1293	Plugs & socket outlets of rated voltage upto and including 250 Volts & rated current upto and including 16 amps

2.0.4.3 Lighting Wires / Cables

(i)	IS:694	PVC Insulated cables for working voltages upto and including 1100V.
(ii)	IS:3961	Recommended current ratings for cables (PVC Insulated and PVC sheathed heavy duty cables and light duty cables)
(iii)	IS:8130	Conductors for insulated electric cables and flexible cords.
(iv)	IS:10810	Methods of tests for Cables

2.0.4.4 Electrical Installation & Miscellaneous :

(i)	IS:2062	Steel for general structural purposes.
(ii)	IS:6665	Code of practice for industrial lighting.
(iii)	IS:374	Electric ceiling fans & regulators

(iv)	IS:5216	Recommendations on safety procedures and practices in electrical work.
(v)	IS:732	Code of practice for electrical wiring installation (System voltage not exceeding 650 Volts)
(vi)	IS:1255	Code of practice for installation and maintenance of power cables upto and including 33kV rating.
(vii)	IS:3043	Code of practice for earthing.
(viii)	IS:3646	Code of practice of Interior Illumination.
(ix)	IS:1944	Code of practice for lighting of public through fares.
(x)	IS:5571	Guide for selection of electrical equipment for hazardous areas.
(xi)	IS:800	Code of practice for use of structural steel in general building construction
(xii)	IS:2633	Methods of testing uniformity of coating on Zinc coated articles.
(xiii)	IS:6005	Code of Practice for phosphating iron and steel.
(xiv)	IS:371	Ceiling roses
(xv)	BS:6121	Mechanical cable glands
(xvi)	IS:6631	Specification for Steel pipes
(xvii)		INDIAN ELECTRICITY ACT
(xviii)		INDIAN ELECTRICITY RULES
(xix)		NATIONAL ELECTRICAL CODE

2.1 TESTS :

2.1.1.1 All equipments to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

2.1.1.2 In case the Contractor is not able to submit report of the type test (s) conducted within last five year from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contact free of cost to the BHEL / Owner and submit the reports for approval.

2.1.1.3 All acceptance and routine tests as per the specification and relevant standards shall be carried out . Charges for these shall be deemed to be included in the equipment price.

2.1.2 Selection of samples for type test, acceptance test & routine test and acceptance criteria for all the items shall be as per relevant I.S.

2.1.3 Type test reports of the following items as per relevant standards shall be submitted for approval.

SI.NO.	DESCRIPTION
i	Lighting fixtures of each type.
ii.	Lamps of each type and rating (life cycle and rating test only)
iii.	Lighting panel of each type (Degree of Protection)
iv.	Junction Box of each type (Degree of protection)
v.	Receptacles of each rating.
vi.	M.C.B. of each rating.
vii.	Lighting transformer
viii.	Ballasts

2.1.4 Acceptance Test and Routine Test :

2.1.4.1 All lighting fixtures, lamps and other items shall be subjected to acceptance and routine test, as per relevant specified standards.

2.1.4.2 Junction boxes, switch boxes, receptacle enclosure etc. shall be subjected to physical and dimensional checks.

2.1.5 Galvanizing Tests :

2.1.5.1 The quality of galvanizing shall be smooth, continuous, free from flux, stains and shall be inspected visually.

2.1.5.2 In additional following test shall be conducted as acceptance tests.

(a) Uniformity of coating – The coating of any article shall withstand four 1 minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.

(b) The quality of cadmium/ Zinc plating on items with screw threads shall be free from visible defects such as unplated areas, blisters and modules and shall be inspected visually.

(c) In additional the plating thickness shall be determined microscopically / chemically or electronically.

2.1.6 COMMISSIONING CHECKS :

2.1.6.1 On completion of Installation work the Contractor shall request the Project manager for inspection and test with minimum of fourteen (14) days advance notice.

2.1.6.2 The Project Manager shall arrange for join inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor.

2.1.6.3 The installation shall be then tested and commissioned in presence of the Project Manager.

2.1.6.4 The contractor shall provide all, men material and equipment required to carry out the tests.

2.1.6.5 All rectifications, repair or adjustment work found necessary during inspection, testing and commissioning shall be carried out by the Contractor without any extra cost.

2.1.6.6 The testing shall be done in accordance with the applicable Indian Standards and codes of practices. The following tests shall be specifically carried out for all lighting installation.

(a) Insulation Resistance
(b) Testing of earth continuity path.
(c) Polarity Test of single phase switches
(d) Functional checks

2.1.6.7 The lighting circuits shall be tested in the following manner :

(a) All switches ON and consuming devices in circuit, both poles connected together to obtain resistance to earth.

(b) Insulation resistance between poles with lamps and other consuming devices removed and switches ON.

2.1.6.8 Lux level measurement to prove guranteed Illumination levels. The contractor shall submit a document on methodology of measurement for approval of BHEL / ultimate customer . This will become basis for measurements .

2.2 QUALITY PLAN :

Bidder shall submit immediately after award of Contract Manufacturing Quality plan & field Quality plan in prescribed format for approval of BHEL & customer. These approved Quality plans shall be followed for manufacture and ETC. Where standard quality plans of BHEL or customer are available , these shall be followed after written consent of BHEL/ Customer.

2.3 HANDING & TAKINGOVER :

It is the responsibility of bidder to handover the complete system to BHEL/ ultimate customer. Bidder shall assist BHEL to handover the system supplied by them to ultimate customer.

2.4 DOCUMENTATION :

2.4.1. Information / documents to be submitted by the bidder at tender stage shall be as follows :

(a) Check list
(b) Technical offer with equipment details & the makes, detailed unpriced schedule of equipment / material & spares .
(b) Guaranteed technical particulars.
(c) Activity Schedule.
(d) Catalogues & technical details of equipment / material offered.

2.4.2. Information / documents to be submitted by the Contractor at contract stage shall be as follows :

(a) Type test reports

(b) Manufacturing Quality plan. Where standard Quality plan of BHEL / Customer is available, this shall be followed.

(c) Field Quality plan for receipt, storage, installation, testing & commissioning with details of tests to be conducted and acceptance values .

(d) Outline and general assembly drawings of equipment, lighting layout conduit layout, wiring scheme, Catalogues of equipment, fixing details etc.

(e) Detailed photometric data of luminaires .

(f) Operation & maintenance manuals

(e) End documentation.

For approval 4 copies to be submitted and after approval 10 copies to be submitted unless otherwise specied else where.

SECTION-3

PROJECT DETAILS & GENERAL SPECIFICATION

SITE INFORMATION

	Particular	Details
a)	Owner	UP POWER TRANSMISSION CORPORATION Ltd
b)	Customer	POWERGRID
c)	Project Title	765kV/400kV Agra UPPTCL (New)Substation
d)	Location	AGRA
e)	Transport Facilities	RAOD/TRAIN
	SITE CONDITIONS	
a)	Max. ambient air temp.	50°C
b)	Min. ambient air temp.	0°C
c)	Max. design ambient temp.	50°C
d)	Design reference temp.	50°C
e)	Average Humidity	Max. 100%
f)	Special corrosion conditions	No
g)	Solar Radiation	1.2kW/sqmtr
h)	Atmospheric UV radiation	High
i)	Altitude above sea level	Less than 1000meter
j)	Pollution Severity	High Pollution level (25mm/kV)
k)	Seismic Zone	As per the seismic zone defined in the relevant BIS but not less than 0.3g horrizontal
	WIND DATA	
	Wind velocity	As per IS
	Average No. of thunderstorm days per annum	As per IS

1.0 GENERAL

This Chapter covers Technical Requirements and requirements of auxiliary items.

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

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

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

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

Auxiliary supplies as described below would be available at site.

Normal Voltage (Volts)	Variation in voltage	Frequency (Hz)	Phase	Neutral connection
415	+ 10 %	50 + 5 %	3 Ph- 4wire	Solidly earthed
240	+ 10 %	50 + 5 %	1 Ph-2wire	Solidly earthed
220	+ 10 %	DC		Isolated(2 wire system)
48		DC		Isolated(2 wire system) (+ Earthed)

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

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

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

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

2.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

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

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

3.0 SUPPORT STRUCTURES (If in the scope of Bidder)

a) The support structures should be hot dip galvanised with minimum 610 gram/m2 net of zinc.

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

4.0 STANDARDS

a) The equipment to be furnished under this specification shall conform to latest issue with all amendments of standard specified under respective Chapters of this Specification.The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other. The bidder shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

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

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

5.0 ENGINEERING DATA AND DRAWINGS

5.1 The list of drawings/documents which are to be submitted to the Purchaser shall be discussed and finalised by the Purchaser at the time of award.The supplier shall necessarily submit all the drawings/ documents unless anything is waived.

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

5.3 Drawings

5.3.1 All drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.

5.3.2 Drawings submitted by the Contractor shall be clearly marked with the name of the Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. POWERGRID has standardized a large number of drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings alongwith type test reports) is required. However, distribution copies of standard drawings/documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.

5.3.3 The review of these data by the Purchaser will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Purchaser may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Purchaser shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

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

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

5.7 Approval Procedure

The scheduled dates for the submission of the drawings as well as for, any data/information to be furnished by the Purchaser would be discussed and finalised at the time of award. The following schedule shall be followed generally for approval and for providing final documentation.

i)	Approval/comments/ Purchaser on initial	As per agreed by schedule submission
ii)	Resubmission (whenever	Within 3 (three) weeks from date of comments required)
iii)	Approval or comments	Within 3 (three) weeks of receipt of resubmission.

iv)	Furnishing of distribution copies (5 hard copies per substation and one scanned copy (pdf format) for Corporate Centre)	2 weeks from the date of approval
v)	Furnishing of distribution copies of test reports	
(a)	Type test reports (one scanned softcopy in pdf format per substationplus one for corporate centre & one hardcopy per substation)	2 weeks from the date of final approval
(b)	Routine Test Reports (one copy for each substation)	-do-
vi)	Furnishing of instruction/ copies per substation and one softcopy (pdf format) for corporate centre & per substation)	As per agreed schedule operation manuals (2
(vii)	As built drawings (two sets of per substation & one softcopy (pdf format) for corporate centre& per substation)	On completion of entire works hardcopy

NOTE :

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

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

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

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

(5) The manufacturer shall furnish to the Purchaser catalogues of spare parts.

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

6.0 MATERIAL WORKMANSHIP

6.1 General Requirement

6.1.1 Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering

practice and suitable for the purpose for which they are intended.

6.1.2 Incase where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the Purchaser shall decide upon the question of similarity. When required by the specification or when required by the Purchaser the Contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the supplier.

6.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the BHEL/POWERGRID.

6.1.4 Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

6.1.5 All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, levelling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

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

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

shall be applicable to other consumables too.

6.1.8 Corona and radio interference voltage test and seismic withstand test (for 132kV and above voltage level) procedures for equipments shall be in line with the procedure given at Annexure-A and B respectively.

6.2 Provisions For Exposure to Hot and Humid climate

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

6.2.1 Space Heaters

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

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

6.2.1.3 Suitable anti condensation heaters with the provision of thermostat shall be provided.

6.2.2 FUNGI STATIC VARNISH

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

6.2.3 Ventilation opening

Wherever ventilation is provided, the compartments shall have ventilation openings with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air / dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

6.2.4 Degree of Protection

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

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

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

6.3 RATING PLATES, NAME PLATES AND LABELS

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

6.4 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

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

7.0 DESIGN IMPROVEMENTS / COORDINATION

7.1 The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. However, the Purchaser or the Contractor may propose changes in the specification of the equipment or quality thereof and if the Purchaser & contractor agree upon any such changes, the specification shall be modified accordingly.

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

7.3 The supplier shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

7.4 The supplier has to coordinate designs and terminations with the agencies (if any) who are Consultants/Contractor for the Purchaser. The names of agencies shall be intimated to the successful bidders.

7.5 The supplier will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the Consultants of the Purchaser (if any) during the period of Contract. The Contractor shall attend such meetings at his own cost at POWERGRID Corporate Centre, Gurgaon (Haryana) or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

8.0 QUALITY ASSURANCE PROGRAMME

8.1 To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the supplier's Works or at his Sub-contractor's premises or at the Purchaser's site or at any other place of Work are in

accordance with the specifications, the supplier shall adopt suitable quality assurance programme to control such activities at all points necessary. The detailed programme shall be submitted by the contractor after the award for reference. A quality assurance programme of the supplier shall generally cover the following:

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

(b) Documentation control system;

(c) Qualification data for bidder's key personnel;

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

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

(f) Control of non-conforming items and system for corrective actions;

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

(h) Control of calibration and testing of measuring instruments and field activities;

(i) System for indication and appraisal of inspection status;

(j) System for quality audits;

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

(l) System for maintenance of records;

(m) System for handling storage and delivery; and

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

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

8.2 Quality Assurance Documents

The supplier would be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of POWERGRID/BHEL inspection of equipment/material

9.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

9.1 All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.

9.2 The reports for all type tests as per technical specification shall be furnished by the supplier alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all project with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25

/ 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by POWERGRID or representative authorized by POWERGRID or Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening i.e. 26.08.11. In case the test reports are of the test conducted earlier than 10 (ten) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to BHEL.

However, in case of instrument transformers, the following type tests should have been conducted within 5 (five) years prior to the date of bid opening.

i) Lightning Impulse Test

ii) Switching ImpulseTest

iii) Multiple Chopped Impulse Test (For CT)

iv) Chopped Impulse Test (For CVT)

In case the test reports are of these tests (for instrument transformers) as mentioned above are conducted earlier than 5 (five) years prior to the date of bid opening i.e. 26.08.11, the contractor shall repeat these test(s) at no extra cost to the purchaser.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.
The supplier shall intimate the BHEL/POWERGRID the detailed program about the tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

Further, in case type tests are required to be conducted/repeated and the deputation of Inspector/Purchaser's representative is required, then all the expenses shall be borne by the supplier.

9.3 The Purchaser intends to repeat the type tests on Power Transformer and Shunt Reactor except Dynamic short circuit tests on transformers, for which test charges shall be payable as per provision of contract. The price of conducting type tests shall be included in Bid price and break up of these shall be given in the relevant schedule of Bid Proposal Sheets. These Type test charges would be considered in bid evaluation. In case Bidder does not indicate charges for any of the type tests or does not mention the name of any test in the price schedules, it will be presumed that the particular test has been offered free of charge. Further, in case any Bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected. BHEL/POWERGRID reserves the right to witness any or all the type tests. The BHEL/POWERGRID also reserves the right to waive the repeating of type tests partly or fully and in case of waival, test charges for the same shall not be payable.

The Purchaser shall bear all expenses for deputation of purchaser's representative(s) for witnessing the type tests under this clause except in the case of re-deputation if any, necessitated due to no fault of the purchaser.

For outdoor receptacles, trefoil clamps, diesel engine, alternator, motors, cable

glands, lighting fixtures, ACSR/AAC conductor, IPS aluminum tube and junction boxes, type test reports are not required to be submitted for the makes indicated at Annexure-E /POWERGRID approved list of subvendors. For the new makes(other than those indicated at Annexure-E / POWERGRID approved list of subvendors), type test reports as per relevant standard shall be submitted for POWERGRID's approval.

9.4 The Purchaser, his duly authorised representative and/or outside inspection agency acting on behalf of the Purchaser shall have at all reasonable times free access to the Contractor's/sub-vendors premises or Works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, despatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

9.5 The supplier shall give the Purchaser /Inspector fifteen (15) days written notice for on-shore and six (6) weeks notice for off-shore material being ready for joint testing including contractor and POWERGRID. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Purchaser/inspector, unless witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed alone with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of tests in triplicate.

9.6 The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser /Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

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

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

the equipment in accordance with the Contract and shall give facilities to the Purchaser /Inspector or to his authorised representative to accomplish testing.

9.9 The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.

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

9.11The Purchaser reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipments for these tests shall be provided by the Purchaser.

10.0 TESTS

10.1 Pre-commissioning Tests

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

10.2 Commissioning Tests

10.2.1 The available instrumentation and control equipment will to be used during such tests and the Purchaser will calibrate, all such measuring equipment and devices as far as practicable.

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

10.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.

10.3 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed by POWERGRID on production of requisite documents.

11.0 PACKAGING & PROTECTION

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

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

12.0 FINISHING OF METAL SURFACES

12.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts & bolts and spring washers shall be electro galvanized to service condition 4.All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS:2629.

12.2 HOT DIP GALVANISING

12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

12.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

12.2.3 After galvanizing. no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

12.2.4The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

12.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

12.2.6 Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

12.3 PAINTING

12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the

life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

12.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

12.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.

12.3.4 The exterior and interior colour of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Glossy white colour inside the equipments /boards/panels/junction boxes is also acceptable. The exterior colour for panels shall bematching with the existing panels in case of extension of a substation. Each coatof primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.

12.3.5 In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted alongwith the Bids for Purchaser's review & approval.

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

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

12.3.7 For aluminium casted surfaces, the surface shall be with smooth finish. Further, in case of aluminium enclosures the surface shall be coated with powder (coating thickness of 60 microns) after surface preparation for painting.

13.0 HANDLING, STORING AND INSTALLATION

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

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

13.3 The contractor shall have to ensure that the hard and flat indoor and outdoor storage areas are in place prior to commencement of delivery of material at site. Contractor shall also ensure availability of proper unloading and material handling equipment like cranes etc. and polyester/nylon ropes of suitable capacity to avoid damage during unloading and handling of material at site. All indoor equipments shall be stored indoors. Outdoor equipment may be stored outdoors but on a hard and flat raised area properly covered with waterproof and dustproof covers to protect them from water seepage and moisture ingress. However, all associated control panels, marshalling boxes operating boxes etc. of outdoor equipments are to be stored indoors only.Storage of equipment on top of another one is not permitted if the wooden packing is used. Material opened for joint inspection shall be repacked properly as per manufacturer's recommendations.During storage of material regular periodic monitoring of important parameters like oil level / leakage, SF6 / Nitrogen pressure etc. shall be ensured by the contractor.

13.4 In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

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

13.6 Supplier shall be responsible for examining all the shipment and notify the Purchaser immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. The Contractor shall submit to the Purchaser every

week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

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

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

13.9 The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment which requires indoor storage.

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

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

13.12 Equipment Bases

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

14.0 TOOLS AND TACKLES

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

15.0 AUXILIARY SUPPLY

15.1 The sub-station auxiliary supply is normally met through a system indicated under section "Electrical & Mechanical Auxiliaries" having the following parameters. The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation and PLCC system shall also conform the parameters as indicated in the following.

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/Wire	Neutral connection
415V	± 10%	50 ± 5%	3/4 Wire	Solidly Earthed.
240V	± 10%	50 ± 5%	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	-	Isolated 2 wire System

48V	_	DC	_	2 wire system (+) earthed

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

16.0 SUPPORT STRUCTURE (If in the scope of supplier)

16.1 The equipment support structures shall be suitable for equipment connections at the first level i.e 14.0 meter, 8.0 meter and 5.9 meter from plinth level for 765 kV,420 kV and 245 kV substations respectively. All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.

16.2 Support structure shall meet the following mandatory requirements:

16.2.1 The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 metres.

17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

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

a)	For connecting ACSR conductors		Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617
b)	For connecting equipment ter-minals made of copper with ACSR conductors		Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS:617 with 2mm thick bimetallic liner and all test shall conform to IS:617
c)	For connecting G.I		Galvanised mild steel shield wire
d)	i) Bolts, nuts & Plain, washers	i)	Electrogalvanised for sizes below M12, for others hot dip galvanised.
	ii) Spring washers items 'a' to 'c'	ii)	Electro-galvanised mild for steel suitable for atleast service condition-3 as per IS:1573

17.2 Necessary clamps and connectors shall be supplied for all equipment and connections.The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

17.3 Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.

17.4 Low voltage connectors, grounding connectors and accessories for grounding allequipment as specified in each particular case, are also included in the scope of Work.

17.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous

parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-metallic strips shall be provided for Bi-metallic clamps.

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

17.7 Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of 4" IPS AL. tube as required. In both the cases the clamp height (topof the mounting pad to centre line of the tube) should be same.

17.8 Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.

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

17.10 Clamps and connectors shall be designed to be corona controlled.

17.11 Tests

17.11.1 Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports shall be submitted for approval as per clause 9.2 above except for sl. no.(ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last ten years shall not be applicable).

i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)

ii) Short time current test

iii) Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)

iv) Resistance test and tensile test

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

18.1 All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS-5039/IS-8623, IEC-60439, as applicable, and the clauses given below:

18.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be atleast 2.0 mm thick cold rolled or 2.5 mm hot rolled or alternately 1.6 mm thick stainless steel can also be used. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

18.3 A canopy and sealing arrangements for operating rods shall be provided inmarshalling boxes / Control cabinets to prevent ingress of rain water.

18.4 Cabinet/boxes shall be provided with double hinged doors with padlocking

arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.

18.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

18.6 All boxes/cabinets shall be designed for the entry of cables from bottom by meanof weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet.

Suitable cable gland plate above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

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

18.8 For illumination, a fluorescent tube or CFL of approximately 9 to 15 watts shall be provided. The switching of the fittings shall be controlled by the door switch. .

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

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

18.10 Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

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

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

i) Check for wiring

ii) Visual and dimension check

b) The enclosure of bay marshalling kiosk, junction box, terminal box shall conform to IP-55 as per IS:13947 including application of, 2.5 KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test.

19.0 Deleted.

20.0 TERMINAL BLOCKS AND WIRING

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

20.2 Terminal blocks shall be 650V grade and have continuous rating to carry the maximum expected current on the terminals and non breakable type. These shall be of moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type of Elmex or Phoenix or Wago or equivalent make.

20.3 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

20.4 The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.

20.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.

20.6 The terminal blocks shall be of extensible design.

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

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

20.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

a)	All circuits except CT/PT circuits	Minimum of two of 2.5 sq mm copper flexible.
b)	All CT/PT circuits	Minimum of 4 nos. of 2.5 sq mm copper flexible.

20.10 The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.

20.11 Atleast 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

20.12 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate for outdoor ground mounted marshalling box and the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

20.13 The supplier shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets. For equipments rated for 400 kV and above the wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge overvoltages either transferred through the equipment or due to transients induced from the EHV circuits.

20.14 All input and output terminals of each control cubicle shall be tested for surgewithstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Contractor shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

21.0 LAMPS & SOCKETS

21.1 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

21.2 Hand Lamp:

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

21.3 Switches and Fuses:

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

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

22.0 Bushings, Hollow Column Insulators, Support Insulators:

22.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC- 60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621.The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable.The bidder may also offer composite hollow insulators, conforming to IEC-61462.

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

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

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

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

22.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be

exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

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

22.8 Tests

In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS:2544 & IS : 5621.

23.0 MOTORS

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

23.1 Enclosures

a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP-44 as per IS: 4691.

b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.

c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.

d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

23.2 Operational Features

a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.

b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

23.3 Starting Requirements:

a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.

b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.

c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.

d) Motors when started with the driven equipment imposing full starting torque

under the supply voltage conditions specified under Clause 15.0 shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.

e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

23.4 Running Requirements:

a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.

b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.

c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

23.5 TESTING AND COMMISSIONING

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

(a) Insulation resistance.

(b) Phase sequence and proper direction of rotation.

(c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.

ANNEXURE-A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1. General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 132kV and above.

2. Test Levels:

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

3. Test Methods for RIV:

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 Mhz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified.The specified RIV test voltage for 765kV, 400 kV, 220 KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

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

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

4. Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure

shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

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

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

4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.

4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5. Test Records:

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

a) Background noise before and after test.
b) Detailed procedure of application of test voltage.
c) Measurements of RIV levels expressed in micro volts at each level.
d) Results and observations with regard to location and type of interference sources detected at each step.
e) Test voltage shall be recorded when measured RIV passes through 100microvolts in each direction.
f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE-B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (for 132kV and above)shall be carried out along with supporting structure.

The Bidder shall arrange to transport the structure from his Contractor's premises/POWERGRID sites for the purpose of seismic withstand test only.The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the POWERGRID.

ANNEXURE - A
SCHEDULE OF TECHNICAL DEVIATIONS

Bidder shall list below all technical deviation clause wise w.r.t. tender specifications:

S.No.	Page No.	Clause No.	Deviation	Reason / Justification

Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date:

Tenderer's Stamp & Signature

ANNEXURE- B

GUARANTEED TECHNICAL PARTICULARS

(A)	**Lighting Fixtures & Accessories (Data to be submitted separately for each type and Size)**	
1.	Manufacture's Name and country of manufacture a) Fixture b) Accessories	
2.	Applicable Standards for a) Fixture b) Accessories	
3.	Manufacturer's type and Catalogue no. for a) Fixture b) Accessories	
4.	Nominal working Voltage (Volts)	
5.	Maximum permissible supply Voltage Variation for satisfactory operation of : a) Fixture (+ / -) b) Accessories (+ / -)	
6.	Power factor at nominal working Voltage and frequency	
7.	Full load input current at Nominal working voltage (Amps)	
8.	Power loss per ballast at nominal working voltage and frequency (Watts)	
9.	Maximum hot spot temperature of ballast case (°C)	
10.	Maximum average ballast winding temperature (°C)	
11.	Ambient temperature within the fitting in continuous operation at the design ambient air temperature (°C)	
12.	Insulation class of ballast winding (°C)	
13.	Average life expectancy of : a) Ballasts b) Capacitors c) Lamps	
14.	Lamp output at the design temperature a) After 100 burning hours (lumens) b) After 1000 burning hours (lumens)	
15.	Lamp output at the end of the expected Life period (lumens)	
16.	Average light output of the fitting as a	

	percentage of lamp output. a) Downwards (%) b) Upwards (%)	
17.	Beam angle for flood lights in a) Horizontal plane (Degrees) b) Vertical plane (Degrees)	
18.	Cable / conduit entry size	
19.	Earthing terminal a) Material b) Size and type of cable	
20.	Weights of Fixtures (Kg.)	
21.	a) Starting Current & PF for lamp (Amps) b) Operating current (Amps) c) Time Vs mains current & PF Characteristics during starting to be enclosed. d) Reference cat. No.	
B.	**Junction Boxes (for each type and size)**	
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 (Amps) c) Voltage rating (Volts) d) Stud type (yes /no) e) Provision of insulated Barriers (yes /no)	
6.	Whether descriptive pamphlet is enclosed (yes/no)	
C.	**Lighting Panels (For each type & size)**	
1.	General	
	a) Manufacture's name and country of manufacture	
	b) Indoor /outdoor application	
	c) Design ambient air temp (°C)	
	d) Thickness of sheet steel(mm)	
	e) Degree of protection provided (as per IS:2147 or equivalent)	
	f) Bill of material for various equipment giving make, type, rating etc enclosed.	
	g) Colour of finish paint i) Outside ii) Inside	

	h) Busbar i) Material ii) Temp. rise at rated current over specified ambient (50 ° C) iii) Continuous current rating at 50 ° C ambient temp. iv) Whether suitable for one second current rating of 5 kA, AC or 4kA D.C as applicable . v) Cross Section vi) Applicable Standard	
	l) Control Wing i) Material of conductor ii) Size of conductor /dia of wire (mm2)	
	j) Conductor - Solid / Stranded	
	k) Terminal Block i) Make ii) Current rating a) Power terminals (Amps) b) Other terminals (Amps)	
	l) All tests as specified in specifications will be carried out (yes/no)	
2.	Air Break Switches (For each type & size) a) Manufacturer's name and country of manufacture b) Manufacturer's type, description c) Applicable Standard d) Rated voltage (Volts) & Frequency (Hz) e) Rated current (Amps) f) Rated Breaking Current (Amps) g) Maximum through fault current withstand . Derating factor for use under site ambient conditions h) Temperature rise of contacts when carrying continuous rated current under site conditions (°C)	
3.	Fuses (For each type & size) a) Manufacturer's name and country of manufacture b) Manufacture's type, description c) Applicable Standard d) Rated Voltage (Volts)	
	e) Rated current (Amps) f) Whether fuse is mounted on an insulated carrier (yes / no)	

	g) Whether fuse carrier has an aperture for fuse failure indication(yes/no) h) Category of duty (IS:2208) i) Rupturing capacities (Prospective current)(kA) j) Maximum let through current for 1 sec. (kA) k) Whether time/ current characteristics are enclosed (Yes/No.)	
4.	Miniature Circuit Breakers (For each type and rating) a) Manufacturer's name and country of manufacture b) Type c) Rated voltage d) No. of poles e) Frequency f) Current Rating i) Continuous at 50°C ambient (Amps) g) Breaking Capacity (Single pole/Double pole / Tripple pole) i) Symmetrical (kArms) ii) Asymmetrical(kArms) h) Total interrupting Cycle time i) Type of SC Tripping j) Type of overload (thermal/magnetic) k) Terminal Suitable for cable size l) Upto what fault current discrimination between incomer fuse & M.C.B will be obtained m) Miniature breaker conform to	
5.	Contactors for each type(DC/AC) & Size a) Manufacturer's name and Country of manufacture b) Rated voltage & permissible Variation(Volts) c) Rated Burden (kA) d) Rated current (thermal) of main contacts e) No. & type of Aux. Contacts (if any) f) Rated Voltage of coil (Volts) g) Pick up voltage h) Rated duty class i) Drop off voltage j) Applicable standard	

D)	**Lighting Poles (For each type and size)**	
1	Manufacturer's name and country of	

	Manufacturer	
2.	Standards applicable	
3.	Dimensions	
4.	Painting / galvanisation details	
5.	Whether descriptive	
	Pamphlet is enclosed ?	
E)	**Lighting Wires (For each type and Size)**	
1.	Manufacturer's name and country of Manufacturer	
2.	Standard applicable	
3.	Rated Voltage (Volts)	
4.	Continuous current rating when laid in conduit in an ambient temperature of 50°C (Amps)	
5.	Conductor	
	a) Material	
	b) Nominal Cross sectional area	
	c) Number and diameter of wires	
6.	Insulation	
	a) Composition of insulation	
	b) Thickness of insulation	
	c) Tolerance on thickness of insulation	
	d) Specific insulation resistance at 60 deg.C.	
7.	Colors scheme for identification of wires	
8.	Whether descriptive Pamphlet is enclosed ?	
G.	**Painting , Prime , Finish Coat**	
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 & Microns	
3.	Applicable Standards	

ANNEXURE- C

CHECK LIST FOR ILLUMINATION SYSTEM

TO BE FILLED AND RETURNED WITH THE OFFER DULY SIGNED

Please mark "YES" if the specified requirement is met or put a mark "NO" if the specified requirement is not met and give reason in column 5
BHEL Enquiry no :
Bidder offer reference :

Sl. no	Parameter	Data (Where possible shall be filled before issue of Spec.)	Bidder's conformation	Reason for non-compliance
(1)	(2)	(3)	(4)	(5)
1.	Provision of illumination for specified areas as per spec.		YES / NO	
2.	Guaranteeing the illumination levels specified as per spec.		YES / NO	
3.	Type of lighting luminaries included as per spec.		YES / NO	
4.	Lighting DBs & LPs included as per spec.		YES / NO	
5.	Lighting transformer included company with specification requirements		YES / NO	
6.	Lighting poles included as per spec.		YES / NO	
7.	Sockets, Plugs & other items included as per spec.		YES / NO	
8.	ETC of Package included in the offer		YES / NO	
9.	Supply & ETC of all wires / Cables / earthing material required for the package other than the items supplied by BHEL included in the package.		YES / NO	
10.	ETC of BHEL supplied Cables included in the offer		YES / NO	
11.	ETC of BHEL supplied earthing strip included in the offer		YES / NO	
12.	Additional flood light luminaries in		YES/ NO	

	switchyard for maintenance of equipment specified in specification included in offer.			
13.	Type and lumen output of lamps included in the offer are as per specification.		YES / NO	
14.	Whether any new item other than the BOQ given required to meet the specification requirement.		YES/ NO	
15.	If new item is required whether these are listed with quantities in the offer		YES/ NO	
16.	Equipment included suitable for operation on voltage & frequency Variation limits specified in the specification without effecting their performance			
17.	Power factor of lamp circuit is as per specification		YES/NO	
18.	Fully filled in GTP enclosed		YES/NO	
19.	Auto change over arrangement for emergency AC/ emergency DC included in EAC & DC boards			
20.	Auto switching arrangement for outdoor flood lighting / street lighting through Timer / Photo call included		YES / NO.	
21.	Spares included in the offer (a) Mandatory (b) Commissioning		YES/ NO YES/ NO	
22.	Activity Schedule enclosed		YES /NO	

Bidder's

Sign :

Date :

Name :

Design :