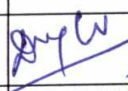
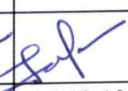
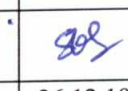


BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

NEW DELHI

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		GROUP	TBEM				
		W.O. No					
CUSTOMER	POWER GRID CORPORATION OF INDIA LIMITED						
PROJECT	Reactor Package RT-03 for 2x63MVAR, 3-Phase, 400kV Bus Reactor at 400/220kV Yelahanka S/S under System Strengthening in Southern Region-XXIII.						
NOA Ref:							
<u>List of Contents</u> Cover Sheet Section 1 Scope & Quantities Annexure -BOQ Section 2 Standard Specification (Specific Technical Requirements) Section 3 Project Details and General Specification TB-403-316-S03 Section 4 Annexure-A (Tech. Compliance certificate) Annexure – A (Schedule of Technical Deviations) <u>No. of Pages</u> 01 06 02 34 71 01 01							
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SECTION-1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

[1] SCOPE

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

The specification comprises of following sections

- | | |
|-----------|--|
| Section-1 | Scope, project specific technical requirements & bill of quantities. |
| Section-2 | Standard Technical Specification for Post Insulators. |
| Section-3 | Project details & general technical Specifications for all the equipments under the project. |
| Section-4 | Annexures |
| | Annexure-A (Compliance Certificate) |
| | Annexure-B (Schedule of Technical Deviations) |
| | Annexure-C (Technical Check List) |

In case of any discrepancies between the requirements mentioned under different Sections of technical specifications, order of precedence shall be as follows:

Section-1 shall precede Section-2, Section-2 shall precede Section-3.

In general, no deviation from the requirements specified in various clauses of this specification shall be allowed and hence, a certificate to this effect shall have to be furnished along with the offer (**Annexure-A**), however bidder shall furnish list of conflicts/ ambiguities/ deviations (if any) in *Schedule of Technical Deviations* (**Annexure-B**). Any conflicts/ ambiguities/ deviations mentioned elsewhere in technical offer shall not be reviewed. In case the deviations mentioned in the *Schedule of Technical Deviations* are not technically acceptable, the offer of the bidder will be liable to rejection.

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] The Illumination equipment are required for the following Project.

Customer: Power Grid Corporation of India Ltd.

Project: Reactor Package RT-03 for 2x63MVAR, 3-Phase, 400kV Bus Reactor at 400/220kV YELAHANKA S/S under System Strengthening in Southern Region-XXIII.

The scope of supplies shall be as per commercial terms and conditions enclosed separately with the enquiry.

[3] SPECIFIC TECHNICAL REQUIREMENTS

This specification covers the specific technical requirements of Illumination system comprising **Design, engineering**, manufacture, Supply, packing and dispatch of equipment & material to site.

The Illumination System shall be provided for the Switchyard Area.

3.1 Complete lighting and illumination for the above shall be provided by the bidder as per Annexure BOQ.

3.2 The Contract shall be on item rate basis for the Outdoor Switchyard. 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.

3.3 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.

3.4 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.

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

[4] DESIGN CRITERIA

4.1 The outdoor switchyard shall be illuminated using LED flood lights as mentioned in customer's section project for illumination system.

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

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

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

4.5 The contractor shall submit detailed calculation for reaching the Lux level (as if applicable) for Employer's approval during detailed engineering.

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

4.7 Bidder to submit detailed "guaranteed and technical particulars" and "detailed drawings" for illumination equipments during contract stage for

approval. Bidder may need to visit BHEL / Powergrid office for drawing / document approval.

4.8 Earthing of Junction box & Lighting Panels etc is to be done by 50X6 GI Flat.

4.9 Earthing of Lighting Poles (for lighting poles outside switchyard) is to be done by **20** mm dia 3000 mm long rod electrode.

4.10 All lighting panels, junction boxes, receptacles fixtures, conduits etc. shall be grounded in compliance with the provision of I.E. rules.

[5] SCOPE OF SUPPLIES

5.1 The equipment 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.

5.2 Tentative quantities are mentioned in BOQ. Actual quantities to be supplied shall be as per the quantities approved based on design drawings. Bidder has to work out the design and indicate at bid stage, if change in quantity is required.

5.3 The Following items are not in bidder's scope of supply:

- (a) Multicore Power Cables as listed in BOQ
- (b) 75X12 and 50X6 mm Galvanized strip for Earthing
- (c) 110mm / 50mm PVC Pipe for buried cable trench
- (d) 40mm MS Rod

5.4 LIGHTING JUNCTION BOX - The Contractor shall supply junction boxes complete with terminals as **required. The brackets, bolts, nuts, screws etc required for erection are also included in the scope of the Contractor.**

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

5.6 Supply of all other items such as wires, steel wire etc required to complete the works are in bidder's scope.

[6] BILL OF QUANTITY – refer attached Annexure_BOQ Illumination system

6.1 Total contract value may vary up to $\pm 30\%$ at contract stage.

6.2 All floor/structure mounting hardware shall be Hot Dip Galvanised and to be supplied complete with hardware i.e. nut bolt washers etc.

[7] Erection, testing and commissioning

7.1 Design of outdoor lighting system including Lux Level calculation, Lighting Layout, Power Distribution scheme, detailed Cable Schedule & Bill of Qty is in bidder's scope as per attach Annexure-BOQ and price schedule.

7.2 **ETC** is not in bidder's scope. However, Bidder to provide procedure / inputs / manual for installation purpose.

[8] TECHNICAL QUALIFYING REQUIREMENT

Bidder should have Powergrid approved drawings, documents and MQP for offered Panel, Junction Box & Lighting Fixtures as on scheduled date of technical bid opening of this tender.

[9] TYPE TESTING

Please refer Section-2 of technical specification for the details of type test requirement.

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.

The reports for all type tests as per technical specification shall be furnished by the bidder along with equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID (in the projects similar to present project) shall be applicable for all projects with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located or as applicable) or witnessed by POWERGRID or representative authorized by POWERGRID or Utility or representative of accredited test lab.

Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted within last 10 (ten) years from the date of NOA. In case the test reports are of the test conducted earlier than 10 (ten) years from the date of NOA, the contractor shall repeat these test(s) at no extra cost to BHEL / Powergrid.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost and time implication to BHEL/Power grid.

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

Note – (1.) Type test report shall be reviewed for approval in detailed engineering stage only. However, for evaluation purpose, the test reports are to be submitted along with the technical bid.

(2.) NOA stands for *Notification of Award* issued by Powergrid to BHEL for the reference project. **Date of NOA is 25 May 2018.**

Reactor Package RT-03 for 2x63MVAR, 3-Phase, 400kV Bus Reactor at 400/220kV YELAHANKA S/S under System Strengthening in Southern Region-XXIII				
ANNEXURE-BOQ- ILLUMINATION SYSTEM (REV 00)				
S.NO.	DESCRIPTION	UNIT	QTY	DETAILED DESCRIPTION
1	SUPPLY- ILLUMINATION EQUIPMENT : LIGHTING PANEL (OUTDOOR) TYPE ACP-2 AS PER TECHNICAL SPECIFICATION.	NO.	1	Supply of Lighting Panel type ACP-2 as per technical specification - Bus Bars: 415V, 63A, 3 phase 4 wire bus bars with Colored LED indication lamps with fuse for each phase. Incomer: One no. 415V, 63A TPN MCB.Outgoings: 6 nos., 230V, 20A Single Phase feeder with Single Pole MCB and 3 Nos. 230V, 32A TPN MCB with suitable timer and contactor for automatic switching and 1 no. 5/15A Switch with Socket. Mounting: Suitable for Outdoor applications. Powergrid approved make - ref Compendium of Vendors for LT Panel
2	SUPPLY- ILLUMINATION EQUIPMENT : OUTDOOR SUB-LIGHTING PANEL (TYPE SLP)	NO.	2	Supply of Sub Lighting panel SLP (Switchyard and Street Lighting) - Incomers: 4 pole 32A TPN MCB suitable for 415V AC supply. Outgoings: 8 nos. terminal blocks suitable for cable upto 16 sq. mm cable. Mounting: Suitable for Outdoor applications with Loop in and Loop out facility. Powergrid approved make - ref Compendium of Vendors for LT Panel
3	SUPPLY- ILLUMINATION EQUIPMENT : LED FLOOD LIGHTING FIXTURES- TYPE " FL1" AS PER TECHNICAL SPECIFICATION	NO.	6.0	
4	SUPPLY- ILLUMINATION EQUIPMENT : LED FLOOD LIGHTING FIXTURES- TYPE " FL2" AS PER TECHNICAL SPECIFICATION	NO.	6.0	
5	SUPPLY- ILLUMINATION EQUIPMENT : PORTABLE FLOOD LIGHT PANEL WITH LED LUMINARIES TYPE FL-2 (250W)	NO.	1.0	Supply of Portable Flood Light Panel with LED Luminaries type FL-2 (250W) as per technical specification.
6	SUPPLY- ILLUMINATION EQUIPMENT : OUTDOOR POWER RECEPTACLE FOR OIL FILTRATION UNIT (250A)	NO.	1.0	
7	SUPPLY- ILLUMINATION EQUIPMENT : OUTDOOR JUNCTION BOX FOR LOOP IN LOOP OUT	NO.	2.0	Outdoor Junction Box with 8 Numbers termnal blocks suitable for 16 Sqmm Cable, for loop in & loop out purpose.

Reactor Package RT-03 for 2x63MVAR, 3-Phase, 400kV Bus Reactor at 400/220kV YELAHANKA S/S under System Strengthening in Southern Region-XXIII				
ANNEXURE-BOQ- ILLUMINATION SYSTEM (REV 00)				
S.NO.	DESCRIPTION	UNIT	QTY	DETAILED DESCRIPTION
8	SUPPLY- ILLUMINATION EQUIPMENT : GI MOUNTING STRUCTURE FOR INSTALLATION OF SUB- LIGHTING PANEL (SLP). BOTTOM OF SLP SHOULD BE MINIMUM 800MM ABOVE FGL. FRAME SHOULD BE OF SUFFICIENT IN HEIGHT AND SUITABLE FOR DIRECT BURIED TYPE FOUNDATION WITH MINIMUM DEPTH OF 250MM. INCLUDING NUT, BOLT WASHERS ETC COMPLETE.	SET	2	
9	SUPPLY- ILLUMINATION EQUIPMENT : GI MOUNTING STRUCTURE FOR INSTALLATION OF OUTDOOR JUNCTION BOX. BOTTOM OF JB SHOULD BE MINIMUM 800MM ABOVE FGL. FRAME SHOULD BE OF SUFFICIENT IN HEIGHT AND SUITABLE FOR DIRECT BURIED TYPE FOUNDATION WITH MINIMUM DEPTH OF 250MM. INCLUDING NUT, BOLT WASHERS ETC COMPLETE.	SET	2.0	
10	SUPPLY- ILLUMINATION EQUIPMENT : GI MOUNTING HARDWARE SUITABLE FOR MOUNTING OF LIGHTING FIXTURE TYPE (FL1) ON EXISTING LATTICE TYPE TOWER STRUCTURE, INCLUDING NUT, BOLT WASHERS ETC. COMPLETE.	SET	6.0	
11	SUPPLY- ILLUMINATION EQUIPMENT : GI MOUNTING HARDWARE SUITABLE FOR MOUNTING OF LIGHTING FIXTURE TYPE (FL2) ON EXISTING LATTICE TYPE TOWER STRUCTURE, INCLUDING NUT, BOLT WASHERS ETC COMPLETE.	SET	6.0	
12	SUPPLY- ILLUMINATION EQUIPMENT : GI MOUNTING STRUCTURE FOR INSTALLATION OF 250A WELDING RECEPTACLE . BOTTOM OF WELDING RECEPTACLE SHOULD BE MINIMUM 800MM ABOVE FGL. FRAME SHOULD BE OF SUFFICIENT IN HEIGHT AND SUITABLE FOR DIRECT BURIED TYPE FOUNDATION WITH MINIMUM DEPTH OF 250MM. INCLUDING NUT, BOLT WASHERS ETC. COMPLETE.	SET	1.0	
13	SERVICES- ILLUMINATION EQUIPMENT : DESIGN OF OUTDOOR LIGHTING SYSTEM INCLUDING LUX LEVEL CALCULATION, LIGHTING LAYOUT, POWER DISTRIBUTION SCHEME, DETAILED CABLE SCHEDULE & DETAILED BILL OF QTY	LOT	1.0	

Section -LIGHTING SYSTEM (Rev.06)

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2.	GENERAL DESIGN CRITERIA	1
3.	GRID INTERACTIVE SOLAR PV POWER PLANT	2
4.	LIGHTING SYSTEM DESCRIPTION	2
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.	Annexure-I Bill of Quantity	
	Annexure-II Details of Lighting Fixture	
	Annexure-III Technical Specification of Grid Interactive Solar PV Power Plant	
	Annexure-IV Drawing of Portable Flood Light Panel (PFL)	
	Annexure-V Drawing of Lighting Pole	

Section -LIGHTING SYSTEM (Rev.06)

Major Changes in Technical Specification Lighting System (Rev.06):-

1. Quantities of Indoor Lighting Fixtures for Control Room cum Administrative Building, GIS Building, FFPH and SPR have been specified in the Specification thus avoiding the designing requirement of Indoor Lighting System. In view of the same LUX Level for various building has not been mentioned in specification.
2. For Outdoor Lighting, LED fixtures of 150W & 250W has been specified in place of Conventional Sodium Vapor Lamps (to be supplied as per BPS).
3. Bidder shall be required to submit LM-79, LM-80 and TTC reports for LED Luminaries.
4. Firewall mounted Flood Lights have been envisaged for Transformer & Reactors (to be supplied as per BPS).
5. Portable Flood Light Panel for Maintenance purpose has been specified. Typical Drawing is also enclosed (to be supplied as per BPS).
6. Roof top Solar Grid System with battery **has been replaced** by Grid Interactive Roof Top Solar Grid System of 15kW to be integrated in ACDB. (to be supplied as per BPS).
7. Considering maintenance issue of Pole mounted battery, **Solar Panel alongwith battery** used for Street Lighting System has been deleted and Street Lighting using LED Luminaries is retained.
8. AC Emergency Lighting in GIS building, SPR, DG Area and LT Transformer Area has been specified.
9. DC Emergency Lighting added for GIS building.
10. Lighting System for Township Area deleted.
11. Stainless steel Panels/Junction Boxes of thickness 1.5 mm for Outdoor application has been specified.
12. Indoor Lighting Panels Bus Bar has been changed from Copper to Aluminum Alloy.
13. Technical Specification for Receptacle RQ-1 (250A) & RQ-2 (400A), 415V, 3-phase has been included for Oil filtration purpose.
14. All concealed Conduit shall be PVC type and all surface mounted conduit shall be of Galvanized steel.
15. Lighting Steel tubular Poles **painting** changed to hot deep galvanizing with PU (Polyurethane) coating in Suzuki Silver color.
16. Fixtures Model and Vendor names have been deleted and general technical parameters of LED fixtures have been included for Indoor as well as Outdoor Fixtures.

Note: Above are major changes made in the Model TS , however Bidder is advised to refer Technical Specification in detail for other changes in the specification.

Section -LIGHTING SYSTEM (Rev.06)

1

GENERAL

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 with electronic regulators, exhaust fans with accessories, lighting panels, Sub-Lighting Panels, lighting poles with distribution boxes, PVC conduits, lighting wires, G.I. earth wire, receptacles, tag block & telephone socket, switchboards, modular switches, junction boxes, pull out boxes, aluminum ladders for maintenance, **solar grid system** complete with accessories. The bidder shall quote on unit rate basis as indicated in bid proposal sheets for outdoor Illumination and lump sum basis for Indoor Illumination. Various type of outdoor & indoor Lighting fixtures required are detailed in Annexure-II.

The following specific areas are included in the scope of lighting as applicable (as per BPS):

i) Indoor Lighting

- a) Control Room cum administrative building
- b) Firefighting pump house
- c) Switchyard panel rooms
- d) GIS Building
- e) Other Buildings

ii) Outdoor Lighting

- a) Switchyard Area including DG Set & LT Transformer area
- b) Street Lighting
- c) Open Store

2

General Design Criteria

The illumination system shall be designed on the basis of best engineering practice and shall ensure uniform, reliable, aesthetically pleasing and glare free illumination. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection. The diffusers/ louvers used in the lighting fixtures shall be made of impact resistant polystyrene sheet and shall have no yellowing property over a prolonged period Illumination. The Lighting Fixture to be used in different areas shall be as per Annexure-I.

For Indoor and Outdoor Illumination, detailed drawings showing the lighting layout, Conduit 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, lighting panels etc. While finalizing the detailed layout of lighting fixtures, the position/location and layout of equipments should be taken into account to have adequate illumination at desired locations with Bill of Quantities requirement as per Annexure-I.

Section -LIGHTING SYSTEM (Rev.06)

2.1 Indoor Illumination

Indoor illumination shall be done by LED Luminaries as per the requirement of false ceiling and non-false ceiling of buildings.

2.2 Outdoor Illumination

Outdoor illumination shall be done by LED luminaries as per the requirement. For Outdoor Switchyard area, LED fixtures shall be installed at gantry structures (For 400kV & below voltage level) & available lightning masts (if any). However for 765kV Switchyard, LED fixtures will be installed at 28 meter height on the towers. For other outdoor areas, Street Lighting, lighting poles & nearby buildings (if any) shall be used for installation of LED fixtures. Mounting structure /Accessories for Mounting of LED Lighting Fixtures will be prefabricated and will be hot dip galvanized. Additional firewall mounted Flood Lights have to be provided for Transformer & Reactors as specified in the BPS.

Portable Flood Light Panel (PFLP): Portable Flood Light Panel along with fixture is to be supplied as per BPS for maintenance purpose of the Substation. The detailed drawing for the FLP shall be as per the drawing attached in the specification (Annexure-IV).

3 GRID INTERACTIVE SOLAR PV POWER PLANT

Solar Grid System (if specified in BPS) shall be supplied as per detail mentioned in as per Annexure-III.

4 LIGHTING SYSTEM DESCRIPTION

The lighting system shall comprise of the following:

4.1 AC Normal Lighting System

All the Lighting fixtures connected to the AC Normal Lighting system in different areas will be fed from the 415 V main lighting distribution board through Lighting Panel & Sub-lighting panels (SLP).

4.2 AC Emergency Lighting System

This system will be provided in Control Room building, GIS Building, Switchyard Panel Room, Fire fighting pump house, Switchyard Area including DG Set & LT Transformer Area. AC Emergency lighting load will be connected to this system which will be normally 'ON'. The lighting panels of this system will be connected to the 415 V Emergency lighting distribution board (ELDB) which is fed from diesel generator during the emergency. Approximate 25 % of lighting fixtures (distributed over all above areas) shall be connected on AC emergency lighting system.

Section -LIGHTING SYSTEM (Rev.06)

4.3 D.C. Emergency lighting System

DC emergency lighting fixtures with 60 W GLS Lamp shall be operated on the 220/110V DC system (as per available Station DC Supply) and will be provided in the strategic locations including Control Room Building, Fire Fighting Pump House, GIS Building and other critical areas etc.

The supply to the DC lighting panels shall be automatically switched ON in case of loss of Normal & Emergency AC supply at station or when under voltage occurs in the AC MLDB. The DC supply will be automatically switched OFF after about 3 minutes following the restoration of supply to normal AC or emergency AC lighting system.

Exit Lightings Signage are to be provided in the all rooms of Control Room Building, Fire fighting pump house & GIS Building including Corridors & Staircase so that the operating personnel can safely find their way even during emergency of total AC failure.

4.4 DESCRIPTION OF ITEMS

The Contractor shall supply and install the following equipment and accessories in accordance with the specification and applicable standards:

4.4.1 LED LUMINAIRES

LED Luminaries shall be used for the lighting of all the indoor and outdoor areas. In false ceiling area LED luminaries shall be recessed mounting type & in non-false ceiling area the LED luminaries shall be surface mounting type.

Suitable heat sink with proper thermal management shall be provided in the luminaries. All LED Luminaries LED luminaries shall be POWERGRID approved make. The marking on luminaries & safety requirements of luminaries shall be as per IS standards.

Necessary Care shall be taken so that there is no water stagnation anywhere in the Luminaries. The entire housing shall be dust and water proof protection as per IS 12063.

4.4.2 LIGHTING PANELS

4.4.2.1 CONSTRUCTIONAL FEATURES OF LIGHTINNG PANELS

- i) Each panel shall be provided with one incoming triple pole Miniature Circuit Breaker (MCB) with neutral link and outgoing MCBs. The panels shall conform to IS-8623.
- ii) All Outdoor Lighting Panels shall be Stainless sheet steel of Grade 304 and shall be dust, weather and vermin proof. Panels shall be of thickness not less than 1.5 mm smoothly finished, leveled and free from flaws. Stiffeners shall be provided wherever necessary.

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- iii) 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 Lighting panels shall be modular flush mounted and wall embedded of slim depth.
- iv) All panels shall have a dead front assembly provided with hinged door(s) and with suitable locking arrangement.
- v) All Outdoor panel's removable covers and doors shall be gasketed all around with neoprene/EPDM gaskets/ puff arrangement.
- vi) The outdoor panels shall be suitable for cable/conduit entry from the bottom. Suitable removable cable gland-plate shall be provided in the bottom of panels. For indoor lighting panels the provision of cable/conduit entry shall be from both top and bottom side with suitable removable gland plate. The thickness of the gland plate shall be 3 mm. Necessary number of double compression brass type cable gland shall be supplied, fitted on to these gland plates.
- vii) The panels shall be so constructed as to permit free access to connection of terminals and easy replacement of parts.
- viii) Each panel shall have a caution notice fixed on it.
- ix) Each panel will be provided with laminated as built circuit diagram suitably pasted in the panel.
- x) **Main Bus Bars**
Bus bars shall be of aluminum alloy conforming to IS: 5082 and shall have adequate cross-section to carry the rated continuous current 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.

4.4.2.2 **CONFIGURATION OF INDOOR AND OUTDOOR LIGHTING PANELS**

Type of Panel	Description	Detail Of Feeders
ACP 1	Indoor AC Lighting panel	Bus Bars: 415V, 63A, 3 phase 4 wire bus bars with Colored LED indication lamps with fuse for each phase. Incomer: One no. 415V, 63A TPN MCB with 300mA 63A Four Pole RCCB. Outgoings: 12 nos. 230V, 16A Single Phase feeder with Single Pole MCB and 1 no. 5/15A Switch with Socket. Mounting: The indoor ACP shall be of slim depth suitable for embedding in the wall and will be flush mounted.

Section -LIGHTING SYSTEM (Rev.06)

ACP 2	Outdoor-Switchyard AC Lighting panel	Bus Bars: 415V, 63A, 3 phase 4 wire bus bars with Colored LED indication lamps with fuse for each phase. Incomer: One no. 415V, 63A TPN MCB. Outgoings: 6 nos., 230V, 20A Single Phase feeder with Single Pole MCB and 3 Nos. 230V, 32A TPN MCB with suitable timer and contactor for automatic switching and 1 no. 5/15A Switch with Socket. Mounting: Suitable for Outdoor applications.
ACP 3	Outdoor - Street AC Lighting Panel	Bus Bars: 415V, 63A, 3 phase 4 wire bus bars with Colored LED indication lamps with fuse for each phase. Incomer: One no. 415V, 63A TPN MCB. Outgoings: 3 nos. 32A TPN MCB with suitable timer and contactor for automatic switching and 1 no. 5/15A Switch with Socket. Mounting: Suitable for Outdoor applications.
DCP	Indoor-DC Lighting panel	Bus Bars: 220/110V DC (as applicable) 32A two wire Bus Bar. Incomers: 220/110V DC (as applicable) with one 32A DP Contactor backed up by 32A double pole MCB. Outgoings: 6 nos.16 A Double Pole MCB Mounting: The indoor DCP shall be of slim depth suitable for embedding in the wall and will be flush mounted
SLP	Outdoor Sub-lighting panel	Incomers: 4 pole 32A TPN MCB suitable for 415V AC supply Outgoings: 8 nos. terminal blocks suitable for cable upto 16 sq. mm cable. Mounting: Suitable for Outdoor applications with Loop in and Loop out facility.

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Sub-DB	Indoor Type AC Sub Distribution Box	Incomers: 32A TPN MCB suitable for 415V AC supply. Outgoings: 6 nos. 230V, 16A Single Phase feeder with Single Pole MCB. Mounting: The MCB Box shall be of slim depth suitable for embedding in the wall and will be flush mounted/surface mounted as per site requirement.
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4.4.2.3 AUXILIARY ITEMS FOR LIGHTING PANELS

(i) TERMINAL BLOCKS

Each terminal shall be suitable for termination of suitable size of Cable/Wire Conductors without any damage to the conductors or any looseness of connections.

(ii) RESIDUAL CURRENT CIRCUIT BREAKERS (RCCB)

For indoor panels (ACP 1), 63A, 4pole 300 mA RCCB conforming IS 12640 will be provided along with incomer.

(iii) 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 characteristics as per IS 8828 will be used for Illumination purposes.
- b) The MCBs and MLDB panel MCCBs 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 backup MCCB in such a way that if fault current is higher than breaker rating, the MCCB should blow earlier than the MCB. If the fault current is less than MCB breaking capacity, MCB shall operate first and not the incomer MCCB.
- c) 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.
- d) The terminals of the MCBs and the 'open/trip' and 'close' conditions shall be clearly and indelibly marked.

(iv) CONTACTORS

Contactors shall be of the full voltage, direct-on line air break, single throw, electro-magnetic type. They shall be provided with at least 2'NC' and 2'NO' auxiliary contacts. 3-Phase Contactor shall be provided with the three

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elements, 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 bidder shall check the adequacy of the Contactors rating, wire with respect to lighting load.

(v) 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.

(vi) LABELS

- a) Designation labels shall be provided on the front of lighting Panels. The panel designation labels shall be of 3 mm thick plastic plate. 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 lamicaid. Labels shall have white letters on black or dark blue background.

(vii) 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.

4.4.3 RECEPTACLES

Suitable number of 63A, 3ph, 415V AC receptacles shall be provided for welding purposes in GIS Halls and near major equipments in switchyard. 250A/400A Receptacle shall be provided for oil filtration purpose near alternate Transformer/Reactor. All receptacles shall be of heavy duty type, suitable for fixing on wall/column and complete with individual switch. The outdoor Receptacles shall have IP 55 protection. The receptacles shall be of following types:

Type RO-20A, 240V, 3 pin type (third pin grounded) plug and socket with body earthing arrangement with Single Pole MCB, metal clad with gasket having cable gland entry suitable for 2Cx6 sq.mm. PVC/aluminum armoured cable and a metallic cover tied to it with a metallic chain and suitable for installation in moist outdoor location. Receptacles shall be housed in an enclosure made out of 2 mm thick Stainless Steel of Grade 304 with hinged doors with suitable locking arrangements. Door shall be lined with good quality gasketing.

Type RP - 63A, 415V, 3 phase, 4 pin interlocked plug and socket with body earthing arrangement with TPN MCB. The receptacle shall be suitable for 3.5C x 35/3.5Cx70 sq.mm and suitable for installation in moist outdoor location. Aluminum conductor cable entry and shall also be suitable for loop-

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in and loop out connection of cables of similar size. Receptacles shall be housed in a box made out of 2mm thick Stainless Steel of Grade 304, with hinged door with suitable locking arrangement. Door shall be lined with good quality gasketing.

Type RQ-1 for 250A/ Type RQ-2 for 400A, 415V, 3 phase, 4 pin, Switch Box with body earthing arrangement with TPN MCB, suitable for outdoor application. The enclosure shall be made out of 2mm thick Stainless Steel of Grade 304, with hinged door with padlocking arrangement and having cable gland entry suitable for 3.5C X 300 sq.mm XLPE armoured cable. The bus bar shall have adequate cross-section to carry the rated continuous current and withstand short circuit currents. The receptacle shall be suitable for loop-in and loop out connection of cables of similar size. Door shall be lined with good quality gasketing.

4.4.4 LIGHTING ACCESSORIES

(i) JUNCTION BOXES

- a) The Indoor junction boxes shall be provided with 4 way knockouts suitable for two numbers 10 sq. mm. wire/ Cable. These junction boxes shall be concealed type for indoor lighting.
- b) The outdoor 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 required size. The junction boxes shall be provided with 4 way knockouts suitable for street lighting/switchyard lighting terminals suitable for 2 numbers 4C x 16 Sq.mm AL cable or as per requirement. All Outdoor Junction boxes shall be of Stainless Steel of thickness 1.6mm of grade 304. Outdoor Junction Boxes shall be suitable for mounting on columns, structures etc for Outdoor Lighting. The outdoor Junction shall have IP 55 protection.
- c) 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.

(ii) OCCUPANCY SENSORS:

Occupancy sensors for indoor use shall be provided in the toilets, stairs area, corridors, Relay room (in case of Centralized Control room), Local Control Room (LCR) in GIS Building. Each occupancy sensor shall be used with suitable programmable time delay to control the illumination in the area. Cost of Occupancy Sensors and associated wiring shall be deemed included in the Illumination System of respective Buildings.

(iii) SWITCH AND SWITCHBOARD

- a) All Switch board/boxes and electronic fan regulators (Step wise) located in office/building areas shall be modular flush mounted type.

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- 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 suitable as per the requirement during installation.
- d) The maximum number of luminaries controlled by one no. 6 Amp Switch shall be 8 nos. However each Switchboard shall have minimum 2 Nos. of 6A Switches to control the Luminaries. For DC fixtures there will be no switch and the same shall be directly controlled from DCP.
- e) The Luminaries shall be wired in such a fashion that luminaries on each phase are evenly distributed all over the room.
- f) 6/16A, 240V AC modular flush mounted socket with switch outlet shall be provided in indoor areas like offices, cabins, Switchyard Panel Room etc.
- g) 25A, 240V AC modular flush mounted socket with switch shall be provided at strategic locations in GIS Halls, ACDB/Switchgear room etc.

(iv) CONDUITS & CONDUIT ACCESSORIES

- a) The conduits shall be Rigid PVC conduits of 20/25 /32 mm dia for Lighting, Telephone wiring & LAN Cabling and shall be ISI marked.
- b) Flexible conduits wherever required shall be PVC type.
- c) All conduits accessories shall be ISI marked.
- d) Galvanized Steel Conduits for Surface Conductor (e.g. GIS Hall).

(v) 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 minimum 16 SWG sheet steel and shall have cover with good quality gasket lining.
- c) The pull out boxes shall be completed with conduit knock outs/threaded hubs and provided at approximately 3 meters intervals in a conduit run.

(vi) CEILING, WALL MOUNTED & EXHAUST FANS AND REGULATORS

- a) The bidder shall supply and install 1400 mm sweep ceiling fans complete with electronic regulator and board for mounting switch, suspension rod,

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canopy and accessories. The electronic regulator for Ceiling fans will be housed in common switchboard for lighting and shall be of similar make and model as that of modular switches. The wall mounted fans shall be of 400 mm sweep. Exhaust fans shall be of 300mm size.

- b) Winding of the fans shall have Class-E insulating material. Winding shall be of copper wire.

(vii) LIGHTING WIRES

- a) Wiring from Lighting/Sub-Lighting Panels to junction boxes / Switchboards/ fixtures etc. is covered under Lighting Wires. The wiring used for lighting shall be standard products.
- b) The wires shall be of 630V grade (Phase to ground), PVC insulated products.
- c) The conductor sizes for wires used for point wiring beyond lighting panels shall be 1.5 sq.mm, 2.5 sq.mm, 4 sq.mm and 6 sq.mm stranded copper wire as required.
- d) The wires used for connection of a lighting fixture from a nearest junction box or for loop-in loop-out connection between two fixtures shall be single core copper stranded conductor, 630V grade (Phase to ground) 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)
 - Green for Earth

4.4.5 LADDER

Following ladders shall be supplied as per BPS for maintenance purpose of illumination system:

- (i) A type Aluminum ladder of 3 Mtr vertical height.
- (ii) Cartwheel mounted aluminum ladder Vertical Extendable from 5.1m to 11m.

4.4.6 LIGHTING POLES

- (i) The bidder shall supply, store and install the following types of galvanized steel tubular lighting poles required for street lighting and decorative lighting, as per the attached drawing of poles.

- (i) Type L1 Street Lighting Pole of 6 meter - for SL-L1 type fixture

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- (ii) Type D1 Post top lantern pole of 4 meter - for SI-D1 type fixture
- (ii) "L1" type poles shall be used for street lighting. "D1" type (Decorative post top lantern) poles and Bollards shall be installed In front of control room building, Fire Fighting Buildings as finalized during detailed engineering.
- (iii) Lighting poles shall be complete with fixing brackets. Cable termination box will be built inside the pole itself as per drawing enclosed.
- (iv) Poles and its Cable termination box shall be hot dip galvanized and PU (Polyurethane) coated in Suzuki silver color and inside with bituminous paint.
- (v) Terminal strips provided in street - lighting poles shall be suitable for terminating up to 2 nos. 4C x 16 sq. mm aluminum cables.
- (vi) 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 Copper wire laid inside the tubular pole.
- (vii) Distance of center of pole from street edge should be approximately 1000 to 1200 mm or as per site conditions.
- (viii) Earthing of the poles should be connected to the switchyard main earth mat wherever it is available, else, the same should be earthed through 3M long, 20 mm dia, earth electrode.

4.4.7

TYPE TEST REQUIREMENT:

- a) Lighting Panels, Receptacles, Junction Boxes etc. shall conform to following degree of protection:
 - (i) Installed outdoor: IP- 55
 - (ii) Installed indoor in air conditioned area: IP-31
 - (iii) Installed in covered area: IP-52
 - (iv) Installed indoor in non-air conditioned area where possibility of entry of water is limited: IP-41.
- b) Lighting fixtures LED type shall conform to type test requirements of LM-79, LM-80 and TTC.

5

LIGHTING SYSTEM INSTALLATION WORKS

5.1

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.

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All apparatus, connections and cabling shall be designed so as to minimize risk of fire or any damage which will be caused in the event of fire. All Lighting accessories mentioned in Clause 1.5.4 shall be supplied and erected as a part of Lighting System Installation works. Cost of all Lighting Accessories, Conduit System, Wiring Cabling work, Foundation & Civil Works is built up in the Cost of the Fixture and no extra payment shall be made for any accessories items for the same.

5.2 Conduit System

- (i) 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, check nuts, male and female bushings (brass or galvanized 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. In case of false ceiling surface conduiting is permissible however all down run conduits will be concealed in wall below the false ceiling. The conduit fittings shall be of the same material as conduits. Separate Conduit should be laid for Communication purpose. The contractor shall also supply & install 20 mm PVC conduit and accessories for telephone wiring and LAN Cabling wherever feasible, telephone and LAN cabling can be laid in the same conduit.
- (ii) All unarmored cables/wires shall run within the conduits from lighting panels to lighting fixtures, receptacles. etc.
- (iii) Size of conduit shall be suitably selected by the bidder.
- (iv) Conduit support shall be provided at an interval of 750 mm for horizontal runs and 1000 mm for vertical runs.
- (v) Conduit supports shall be clamped-on 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 raw plugs. Wooden plug inserted in the masonry or concrete for conduit support is not acceptable.
- (vi) 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.
- (vii) For long conduit run, pull boxes shall be provided at suitable intervals to facilitate wiring.
- (viii) Conduit shall be securely fastened to junction boxes or cabinets, each with a lock nut inside and outside the box.
- (ix) Conduits joints and connections shall be made through water-tight and rust proof by application of a thread compound which insulates the joints. White

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lead is suitable for application on embedded conduit and red lead for exposed conduit.

- (x) The entire GI conduit system (if used) 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.
- (xi) 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.

5.3 Wiring

- i) The scope also includes wiring from nearest Lighting/Sub-Lighting Panel to the Controlling Switch/MCB/Lighting Fixtures.
- ii) 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.
- iii) 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.
- iv) Wiring shall be spliced only at junction boxes with approved type terminal strip.
- v) 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.
- vi) For vertical run of wires in conduit, wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/junction box.
- vii) Maximum two wires can be terminated to each way of terminal connections.
- viii) Separate neutral wires are to be provided for each circuit.
- ix) AC and DC wiring should run through the separate conduits. Similarly Communication wire/cable shall run in separate conduits.

5.4 Lighting Panels

- i) The lighting panels shall be erected at the locations to be finalized during detailed engineering.
- ii) Suitable foundations/supporting structures for all outdoor type lighting panels shall be provided by the Contractor.
- iii) The Sub lighting Panel shall be provided where independent switch of fixtures are required.

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5.5 General Requirements for Cabling Work

- i) Each cable run shall be tagged with number that appears 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.
- ii) 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.
- iii) Location of cables laid directly under ground shall be indicated clearly by cable marker made of galvanized iron plate embedded in concrete block.
- iv) The location of underground cable joints if any shall be clearly indicated with cable marker with an additional inscription "cable joint".
- v) 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.
- vi) Road crossing of cables through suitable size of GI pipe/Hume pipe as required at site.

5.6 Foundation & civil works

- i) Foundation for street lighting poles and panels shall be done by the Contractor.
- ii) All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grouting 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.
- iii) 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.

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ANNEXURE-I

BILL OF QUANTITY

Sr. No	Locations	Type & No of Lighting Fixture	With Anti Glare Film over the Fixture(Yes/No)
01.	Control Room cum Administrative Building-Single Storey (As applicable)		
(i)	Control Room	RSQ-I: 10 Nos.	Yes
(ii)	Station- In Charge (DGM Room)	RSQ-I: 4 Nos. and RC-I : 4 Nos.	Yes
(iii)	Administrative Area	RSQ-I: 12 Nos. and RC-I : 9 Nos.	Yes
(iv)	Conference Room	RSQ-I: 9 Nos. and RC-I : 4 Nos.	Yes
(v)	Electrical Room/ Telecommunication Room	RSQ-I: 4 Nos. and RC-I : 2 Nos.	Yes
(vi)	ACDB/DCDB Room	SL-I: 16 Nos.	Yes
(vii)	Battery & Battery Charger Room	SL-I: 6 Nos.	Yes
(viii)	Corridor & Reception	SC-I: 8 Nos. and SL-I: 2Nos.	Yes
(ix)	Toilets	SC-I: 8 Nos.	No
(x)	Pantry	SL-I: 2 Nos. and SC-I: 1 No.	Yes
(xi)	Periphery of the Building	BL: 10Nos.	No
02.	Control Room cum Administrative Building- Double Storey (As applicable)		
(i)	Control Room	RSQ-I: 12 Nos.	Yes
(ii)	Station- In Charge (Sr. Officer Room)	RSQ-I: 4 Nos. and RC-I : 2 Nos.	Yes
(iii)	Administrative Area	RSQ-I: 16 Nos. and RC-I : 12 Nos.	Yes
(iv)	Conference Room	RSQ-I: 9 Nos. and RC-I : 5 Nos.	Yes
(v)	Electronic Test Lab/ Telecommunication Room	RSQ-I: 4 Nos.	Yes
(vi)	ACDB Room	SL-I: 16 Nos.	Yes
(vii)	DCDB Room	SL-I: 9 Nos.	Yes
(viii)	Battery & Battery Charger Room	SL-I: 6 Nos.	Yes
(ix)	Store	SL-I: 6 Nos.	No
(x)	Lobby/ Waiting Area	SSQ-I: 5 Nos. and RC-I : 4 Nos.	Yes
(xi)	Toilet	SC-I: 12 Nos.	No
(xii)	Pantry	SL-I: 2 Nos. and SC-I: 1 No.	Yes
(xiii)	Corridors	SC-I: 36 Nos. and SL-I: 6 Nos.	No
(xiv)	Periphery of the Building	BL: 15 Nos.	No
03.	GIS Building*		
(i)	765kV GIS Hall	IHB: 10 Nos. per 100 Sq. meter	No
(ii)	400kV GIS Hall	IHB: 8 Nos. per 100 Sq. meter	No
(iii)	220kV GIS Hall	IHB: 6 Nos. per 100 Sq. meter	No
(iv)	AHU Room	SL-1: 8 Nos. per 100 Sq. meter	Yes
(v)	C&R Room	RSQ-I: 10 Nos. per 100 Sq. meter	Yes
04.	Fire Fighting Pump House		
(i)	FFPH Building	SL-1: 9 Nos.	Yes
(ii)	Periphery of the Building	BL: 4 Nos.	No
05.	Switchyard Panel Room (SPR) (9 meter)	SSQ-I: 10 Nos.	Yes
06.	Switchyard Panel Room (SPR) (6 meter)	SSQ-I: 8 Nos.	Yes
07.	Switchyard and Outdoor Substation Area	FL-1 & FL-2: As per BPS	No
08.	Street lighting roads	SL-LI & SL-DI:As per BPS	No

Sr. No	Items	Quantity & Locations
1.	Ceiling Fans	15 Nos.-ACDB/DCDB Room , Reception, FFPH Building & Staff Room
2.	Wall Mounted Fans	6 Nos. Test Lab, Admin. Area & Control Room
3.	Exhaust Fans	8 Nos. FFPH Building, Pantry & Toilets

For GIS Building (Sl. No.3), based on actual area, the Quantity of Lighting Fixtures shall be supplied as per Pro-rata basis for which Bidder has to include in his offer total Quantity of Lighting Fixtures required for entire area of GIS Building to be constructed under the package.

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ANNEXURE-II

Details of Lighting Fixture

(a) Indoor Application

Sr. No	Technical Specification	SL-1 (Surface Mounted Linear LED Tube with Box)	RL-I (Recessed Mounted 4 x 1 Feet LED Panel)	SC-I (Surface Mounted Circular LED Downlight Luminaire)	Type RC-I (Recessed Mounted Circular LED Downlight Luminaire)	Type SSQ-1 (Surface Mounted 2X2 LED Luminaire)	Type RSQ-1 (Recessed Mounted 2x2 LED Luminaire)	Type IHB (LED Indoor High Bay)
1	System Wattage	≤ 2 X 20 W	≤ 40 W	≤ 15 W	≤ 15 W	≤ 40 W	≤40 W	≤150W
2	System Lumen Output	≥ 3600	≥ 3600	≥ 1200	≥ 1200	≥ 3400	≥ 3400	≥14000
3	System efficacy (Lumens/Watt)	≥ 100	≥ 100	≥ 80	≥ 80	≥ 85	≥ 85	≥ 100
4	Housing	CRCA Housing	CRCA Housing	Pressure Die Cast Housing	Pressure Die Cast Housing	CRCA Housing	CRCA Housing	Pressure Die Cast Aluminum Housing
5	Ingress Protection	IP20	IP-20	IP20	IP-20	IP-20	IP-20	IP-65
6	Surge Protector	2kV	2kV	2kV	2kV	2kV	2kV	4kV (Internal) & 10kV (External)
7	Mounting	Surface Mounted	False Ceiling	Surface Mounted	False Ceiling	Surface Mounted	False Ceiling	Hanging Type under Shed
8	THD	<10%	<10%	<10%	<10%	<10%	<10%	<10%
9	CRI	>80	>80	>80	>80	>80	>80	>70
10	CCT	5700k±300k	5700k±300k	5700k±300k	5700k±300k	5700k±300k	5700k±300k	5700k±300k
11	Power Factor	>0.95	>0.95	>0.95	>0.95	>0.95	>0.95	>0.95
12	Ik Protection	NA	NA	NA	NA	NA	NA	IK-05
13	Operating Humidity	90% RH	90% RH	90% RH	90% RH	90% RH	90% RH	90% RH
14	Burning Hours	50,000	50,000	50,000	50,000	50,000	50,000	50,000
15	Operating Temperature	-5°C to 45°C						
16	Lumen Maintenance	70% at the End of Burning Hours						

Section -LIGHTING SYSTEM**Details of Lighting Fixture****(b) Outdoor Application**

Sr.No	Technical Specification	BL (Surface Mounted Bulk Head)	Type SL-L1 (LED Street Light Luminaire)	Type SL-D1 (Pole Mounted LED Post Top Luminaire)	Type FL-1 (LED Flood Light Luminaries)	Type FL-2 (LED Flood Light Luminaries)
1	System Wattage	≤ 10W	≤45W	≤ 30W	≤150W	≤250W
2	System Lumen Output	≥ 800	≥4000	≥ 2600	≥ 14000	≥ 23000
3	System efficacy (Lumens/Watt)	≥ 80	≥ 100	≥ 90	≥ 100	≥ 100
4	Housing	Pressure Die Cast Housing and with Polycarbonate diffuser	Pressure Die Cast	Die Cast Aluminum	Pressure Die Cast Housing	Pressure Die Cast Housing
5	Ingress Protection	IP-65	IP-65	IP-65	IP-65	IP-65
6	Surge Protector(Internal)	3kV	3kV	3kV	3kV	3kV
7	Surge Protector(External)	10kV	10kV	10kV	10kV	10kV
8	Mounting	Wall Mounting	Pole Mounting for 40mm max O.D	Suitable for 60mm max O.D	On Lattice Structure	On Lattice Structure
9	THD	<20%	<10%	<10%	<10%	<10%
10	CRI	>70	>70	>70	>70	>70
11	CCT	5700k±300k	5700k±300k	5700k±300k	5700k±300k	5700k±300k
12	Power Factor	>0.90	>0.95	>0.95	>0.95	>0.95
13	Ik Protection	IK-09	IK-05	IK-05	IK-05	IK-05
14	Operating Humidity	90% RH	90% RH	90% RH	90% RH	90% RH
15	Burning Hours	50,000	50,000	50,000	50,000	50,000
16	Operating Temperature	-5°C to 45°C				
17	Lumen Maintenance	70% at the End of Burning Hours				

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Annexure-III

Technical Specification of Grid Interactive Solar PV Power Plant

1.0 Scope of Work

Design, manufacture, supply, erection, testing and commissioning of "Grid Interactive Solar PV Power Plant of PV array capacity 15 kWp over Control Room . This installation shall be a supplement source to ACDB Bus, to save on conventional energy supply from the grid during solar energy generation from the plant.

The equipment and materials for grid interactive Solar PV Power Plant of array capacity 15 kWp shall include but not limited to the following:

- a) PV Modules (Crystalline)
- b) Module Mounting Structure and frames
- c) Array Terminal Box
- d) Grid Interactive Inverters
- e) AC Sub Junction Box
- f) Grid interfacing LT Panel
- g) Three Phase Import/ Export Energy Meter
- h) Cable & Wires
- i) Chemical Gel Earthing system
- j) Civil works for Foundation of PV Array
- k) Integration with SAS
- l) Signage (Project Name Plate and caution as per IS)

All civil works associated with the installation & commissioning of PV Array shall have to be done by the Contractor including the necessary structural work. The Solar PV Module will be installed over the Control Room Building while the LT panels Inverters etc will be placed in ACDB Room of Control Room Building. The Contractor shall specify and submit detail GA drawing indicating indoor equipments as well as PV Array.

Special maintenance tools and tackle kits which are proprietary in nature) as identified by the Contractor and other associated materials and accessories, which is necessary or usual for satisfactory and trouble-free operation and maintenance of the above equipment

2.0 Codes and Standards

All equipment and materials to be furnished under this specification shall be designed, manufactured and tested in accordance with the latest revisions of the relevant Indian Standard (IS)/IEC as applicable.

The electrical installation shall meet the requirement of Indian Electricity Act, and Indian Electricity Rules as amended up-to-date and also the applicable section of the latest revision of the relevant IS Code of Practice.

3.0 Completeness of Supply

It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall

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conform to highest standard of engineering, design and workmanship in order to suit with installation site with optimal output.

Such works, not listed in the schedule of works but required for completion of the project shall be deemed to have been included in the scope of this bid.

4.0 Solar PV Modules

Desired specification of Solar PV module shall include but not limited to the following:

- Total power plant capacity of Solar PV Array shall be 15 kWp
- Cell of the Modules shall be mono or poly crystalline high power silicon cells. The solar cells shall have surface anti-reflective coating to help to absorb more light in all weather conditions
- Each PV module capacity shall be minimum of 300Wp nominal rating (without any negative tolerance)
- The PV modules must qualify the latest edition of relevant IEC 61215 or IS 14286. The module shall also qualify for IEC 61730 for safety qualification: Part 1-requirement for construction and Part-2 requirements for testing. It should also comply IEC 61701 for Salt Mist Corrosion resistant & IEC 62716 for Ammonia Corrosion resistant.
- Photo Electric Conversion Efficiency of SPV module shall not be less than 15.5%
- Fill factor of the module shall not be less than 0.7
- Each module shall have superior light transmission, low iron, tempered & textured glass with anti reflective coating. It shall also have tough multi-layered polymer back sheet for environmental protection against moisture & provide high voltage electrical insulation.
- Solar PV module shall be highly reliable, light weight and shall be designed to have a long service life.
- The rated output of any supplied module shall not vary by more than 3% from average power rating of all ratings. Each module, therefore, has to be tested and rating displayed.
- The solar modules should have suitable encapsulation & sealing arrangements to protect the silicon cells from the environment. The encapsulation arrangement shall ensure complete moisture proofing for the entire life of solar modules.
- Contractor must consider shading losses as per the relevant industry standard & Practice while designing the proposed power plant.
- The bird spike shall be provided to avoid bird sitting on the solar modules at the highest point of the array/module structure.
- The Solar PV modules are to be installed & fixed with the module mounting structures with appropriate size nuts & bolts made with stainless steel.
- It shall perform satisfactory in relative humidity up to 95% and temperature between -40° C to 85° C. It shall be able to withstand wind gusts as per IS-875 (Part-3) as applicable for respective site.
- PV module junction box shall be IP67 protection class as per IEC 529

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- The Contractor shall provide the sample solar PV module electrical characteristics including current-voltage (I-V) performance curves and temperature coefficients of power, voltage and current of the proposed PV Module (s).
- The following information must be mentioned on the Nameplate used on each module :
 - Name of the manufacturer of PV Module
 - Name of the manufacturer of Solar cells
 - Month and year of the manufacture (separately for solar cells and modules)
 - Country of origin (separately for solar cells and module)
 - I-V curve for the module
 - Peak Wattage, I_m , V_m and Fill Factor for the module
 - Unique Serial No. and Model No. of the modules
 - Date and year of obtaining IEC PV module qualification certificate
 - Name of the test lab issuing IEC certificate
 - Other relevant information on traceability of solar cells and module as per ISO 9000.
- Manufacturer of proposed PV modules must have ISO 9001:2008/ ISO 14001 Certification for their manufacturing unit for the said manufacturing item.

5.0 Module Mounting Structure and frames

- Entire system to be placed by providing necessary steel structures properly grouted on the ground. Any damage done to the roof to be made right after the installation.
- The array structure shall be made of hot dip galvanized MS angles or galvanized tubular frame. The minimum thickness of the galvanization shall be as per Section-GTR.
- The structure shall be designed for simple mechanical and electrical installation. It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly.
- The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels. The structure shall be designed to allow easy replacement of any module & shall be in line with the site requirement. Array structure shall also have tilt arrangement to adjust the plane of the array for optimum tilt.
- The module mounting structure shall have to be designed and fabricated with alignment & optimum tilt angle shall be calculated to provide the maximum annual energy output. This shall be decided based on the location of array installation.
- Minimum Ground Clearance of the lowest part of the module structure should be at least 700mm.
- The support structure design & foundation shall be designed to withstand wind gust as per IS -875 (Part-3) for the respective site conditions.

Section -LIGHTING SYSTEM

- All fasteners for supporting conduits, Nut & Bolts shall be of stainless steel (Grade SS 304), supporting structures including module mounting structure shall have to be adequately protected against all climatic condition
- The array structure shall be grounded properly using maintenance free earthing kit. Since Solar PV Module are roof top mounted , all arrangement for grounding is in the scope of the Contractor.

6.0 Array foundation

The legs of the structures shall be made with hot dip GI angles or tubular supports, which shall be grouted on the concrete foundation. The base plate arrangement may be made on RCC blocks. Grade of concrete for all RCC blocks shall be 1:1.5:3 mix.

The minimum ground clearance from the lowest part of any module shall be 700 mm. While making design, due consideration will be given to weight of module assembly, maximum wind gust as per IS -875 (Part-3) for the respective site conditions. The work includes concreting, reinforcement, shuttering etc. as per direction of POWEGRID.

7.0 Array Terminal Box/Array Junction Box/DCDB

- The junction boxes will have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables.
- The array combiner box shall have IP 65 protection level as per IEC 529 and shall be dust and water proof.
- The array combiner box shall be fitted with input and output terminals, surge suppressors and DC MCBs.
- Suitable markings shall be provided on the lugs or bus-bar for easy identification and cable ferrules will be fitted at the cable termination points for identification.
- The mounting of the accessories in the Combiner Box should be DIN Rail type.
- The Junction Boxes shall have suitable arrangement for the followings:
 - Combine groups of modules into independent charging sub-arrays.
 - Provide arrangement for disconnection for each of the groups.
 - Provide a test point for each sub-group for quick fault location.
 - To provide group array isolation.
 - Current carrying rating of the Junction Boxes shall be suitable with adequate safety factor to inter connect the Solar PV array.
- The make of Junction Boxes/associated accessories like surge suppressors, DC MCBs shall be as per acceptability of POWERGRID

The array combiner box and all of its accessories should be such that it is specifically rated/made for the use of PV system as to be declared by the original manufacturer.

Note : Switches/Circuit Breakers/Connectors wherever used must comply to IEC 60947 Part-1,II,III/ EN 50521 towards General requirements Connectors-Safety (AC/DC)

8.0 Grid Connected Inverter Panel

The inverter shall be pure sine wave inverter of high efficiency. Inverters shall have display to show its own parameters along with the parameters of PV array connected to the Inverter. The inverter shall be compatible as On Grid Connected Mode (Synchronization with grid). The proposed inverter must have test certificates /

Section -LIGHTING SYSTEM

reports from any of the NABL/ IEC Accredited Testing Laboratories or MNRE approved test centers. Desired specification of inverter shall include but not limited to the following:

- The inverter shall be highly efficient based on Maximum Power Point Tracking (MPPT) control with IGBT based design. MPPT must be able to extract maximum energy from Solar array and produce 415 V, 3-ph, 50Hz AC to synchronize with the grid through LT panels.
- MPPT controller, inverter and associated control and protection devices etc. all shall be integrated into Inverter. MPPT voltage range shall be compatible with the array voltage.
- The rating of Inverter(s) shall be suitable to meet Solar PV array capacity
- Inverter shall provide 3 phase, $415 \pm 10\%$ V, $50 \pm 3\%$ Hz supply on AC side with THD<3%.
- DC voltage ripple content shall not be more than 3%.
- Inverter should have built in Module Level Monitoring.
- Rated AC Output Power should be 16000 watt and must have fixed voltage 750V.
- Maximum input voltage should not be less than 900 V.
- Maximum DC Power Module should not be less than 21600 watt.
- Efficiency (Maximum) of Inverter shall not be less than 98% and Euro efficiency (weighted) shall not be less than 97%.
- Degree of protection should not be less than IP-21(in case of Indoor placements) or IP-65 (in case of Outdoor placement) as per IEC 529
- It shall have protection features such as over voltage, under voltage, Short circuit, over temperature, Over Current, over and under grid frequency protection and Anti islanding protection on AC side.
- The system should be capable of providing all the data including that of meter and Inverter to the central software. All the equipments /hardware /software for complying to the same will be in the Contractor's scope.
- Inverter shall be grid interactive in nature.
- Inverter shall be capable of complete automatic operation, including wake-up, synchronization & shut down. Inverter shall have DSP control and shall operate in sleeping mode, when there is no power connected consuming least power consumption to the extent possible.
- Inverter shall continuously monitor the condition of the grid. In the event of grid failure, it shall resynchronize with system in less than two (2) minutes time after the restoration of grid or DG set.
- The Inverter shall not produce Electromagnetic interference (EMI) which may cause malfunctioning of electronic and electrical instruments including communication equipment, which are located within the facility in which the inverter is housed.
- Inverter shall conform to IEC 61683 standard for efficiency measurements, IEC 60068-2 (1, 2, 14, 30)/ equivalent BIS std. for environmental testing.

Section -LIGHTING SYSTEM

- Inverter to be communicable for remote monitoring through SCADA system. Inverter shall have facility to display basic parameters of the system through LEDs & LCD display.

Display

- Grid Voltage & Frequency
- Export Power
- Import Power
- Cumulative Export and Import Energy

Indications

- Line Status
- Inverter under voltage/ over voltage
- Inverter over load
- Inverter over temperature.

Protections

- Over voltage both at input & output
- Over current both at input & output
- Over/ under grid frequency
- Over temperature
- Short circuit
- Protection against lightning
- Surge voltage induced at output due to external source.

9.0 Power Optimizer

- (i) Power Optimizer must Provide Module Level Monitoring.
- (ii) Efficiency should not be less than 99.5%.
- (iii) Rated DC Input Power should be 700 watt.
- (iv) MPPT Operating range should be within 12.5-105 V.
- (v) Unique Safe DC which ensure rapid shutdown when AC grid turned off.
Safety Output voltage per Power Optimizer should be 1Vdc.
- (vi) It should have real time power measurement characteristic.
- (vii) Short circuit current must be 10.1 A & Output current 15A.

10.0 Power Quality Requirements

- (i) **DC Injection into the grid:** The injection of DC power into the grid shall be avoided by using an isolation transformer or other suitable means at the output of the inverter. It is proposed to limit DC injection within 1% of the rated current of the inverter as per IEC 61727.
- (ii) **Harmonics on AC side**
 - (a) The limits for harmonics shall preferably be as stipulated in the CEA Regulations on grid connectivity.

Section -LIGHTING SYSTEM

(b) Voltage Unbalance-The Voltage Unbalance in the grid shall not exceed the permissible limits.

(iii) Voltage Fluctuation

(a) The permissible limit of voltage fluctuation for step changes which may occur repetitively is 1.5%.

(b) For occasional fluctuations other than step changes the maximum permissible limits is 3%.

11.0 Integration with Substation Automation System

Solar PV Plant System shall have provision of following digital inputs for owner's substation automation purpose. These digital inputs shall be made available in the form of potential free contacts to be provided in respective modules. These potential free contacts shall be wired up to respective terminal blocks.

- Monitoring of PV Array/String Power & Energy (Daily/Monthly/Energy) .
- Monitoring of Inverter output data like export/ import of Power & energy, power factor etc.

12.0 AC Distribution/Grid Interface Panel

AC power output of the inverter shall be fed to the AC Distribution Board (metering panel & isolation panel) which also houses energy meter.

All the output of Inverter shall be terminated to the Solar AC Panel through MCCB at the incoming bus (Inverter side). The incoming bus shall be connected to ACDB Bus through a MCCB and an Isolator. Output of Solar AC panel shall be terminated at ACDB bus through separate feeders in such a manner that in the event of non availability of one bus/feeder, Solar PV should continue to feed other healthy bus.

13.0 Energy Meter

3 Ø, 4 wire, 415V AC, Import/ Export Energy Meter (0.5 Class accuracy) of suitable current capacity of any reputed make acceptable to POWERGRID. Meter must be provided with the necessary data cables. The Meter to be supplied must be tested from any of the NABL/ BIS Accredited Testing-Calibration Laboratories. It shall also comply with the requirements of CEA Regulations on "Installation and Operation of Meters". The Energy meter shall be installed at the incoming of the Grid interfacing LT panel.

14.0 Cables & Wirings:

The Specification of wiring material shall include but not limited to the following:

- Rated Voltage for AC/DC cables suitable/ compatible for Installation (AC:0.6/1.1kV, DC:0.9/1.5kV)
- Temp. Range (-)10°C to (+)85°C.
- Will comply IEC 60502/ IS 7098 General Test and Measuring Method XLPE cables for working voltage up to and including 1100 V and UV resistant for outdoor installation]

Section -LIGHTING SYSTEM

- Excellent resistance to Heat, Fire, Oil, cold, water, abrasion, UV radiation
 - Flexible
- i) All cables except the cable from Solar panel to DC junction box i.e. solar cable must be armored.
 - ii) Conductor size of cables and wires shall be selected based on efficient design criteria such that the overall electrical energy loss in any section of cable or wire is not more than 3% under the designed operating conditions. Also wiring size of PV array shall be designed such that maximum voltage drop at full power from the PV modules to Inverter should be less than 3%.
 - iii) Cable terminations shall be made with suitable cable lugs & sockets etc, crimped properly and cables shall be provided with dry type compression glands wherever they enter junction boxes/ panels/ enclosures at the entry & exit point of the cubicles. The panels bottoms should be properly sealed to prevent entry of snakes/lizard etc. inside the panel. All cables shall be adequately supported. Outside of the terminals / panels / enclosures, shall be protected by conduits. Cables and wire connections shall be soldered, crimp-on type or thimble or bottle type.
 - iv) Only terminal cable joints shall be accepted. Cable joint to join two cable ends shall not be accepted.
 - v) The cable must be laid through PVC conduit or metallic pipe. In case of using metallic pipe as conduit proper grounding of the conduit must be done.
 - vi) All cable/wires shall be marked with good quality letter and number ferrules of proper sizes so that the cables can be identified easily.
 - vii) All cable shall be suitably marked or coded for easy identification. Cables and wires shall confirm to the relevant standards like IS etc.
 - viii) Cable tray (metallic preferably aluminum) of suitable size must be used for laying of cable wherever required to protect cable from physical damage.
 - ix) All fasteners shall be made of Stainless steel.

14.1 Lightning & Over Voltage Protection

- SPV Power Plants will be provided with Lightning and Over Voltage Protection connected to proper earth mats.
- The Lightning conductors shall be provided as per Indian Standards (IS) in order to protect the entire Solar Array yard from Lightning strikes.
- Necessary concrete foundation for holding the lightning arresters in position will be made after giving due consideration to maximum wind speed.
- Lightning arresters shall be earthed through flats and connected to earth mats as per applicable IS with Chemical Gel earth pits.
- Necessary Masonry enclosure with proper protection of the earth pit to be provided.

14.2 Earthing

- The complete Solar PV power Plant with all its accessories will be grounded, so that in the event of a lightning strike or utility over voltage, current will find a safe path to earth. Note that a separate grounding would be provided for this purpose, separate from the one used for lightning conductor.
- Solar PV array structure shall be grounded properly as per IS standard.

Section -LIGHTING SYSTEM

- The earth conduction shall run through appropriate pipes partly buried and partly on the surface. The complete earthing system shall be mechanically & electrically connected to provide independent return path to earth.

15.0 Signage:

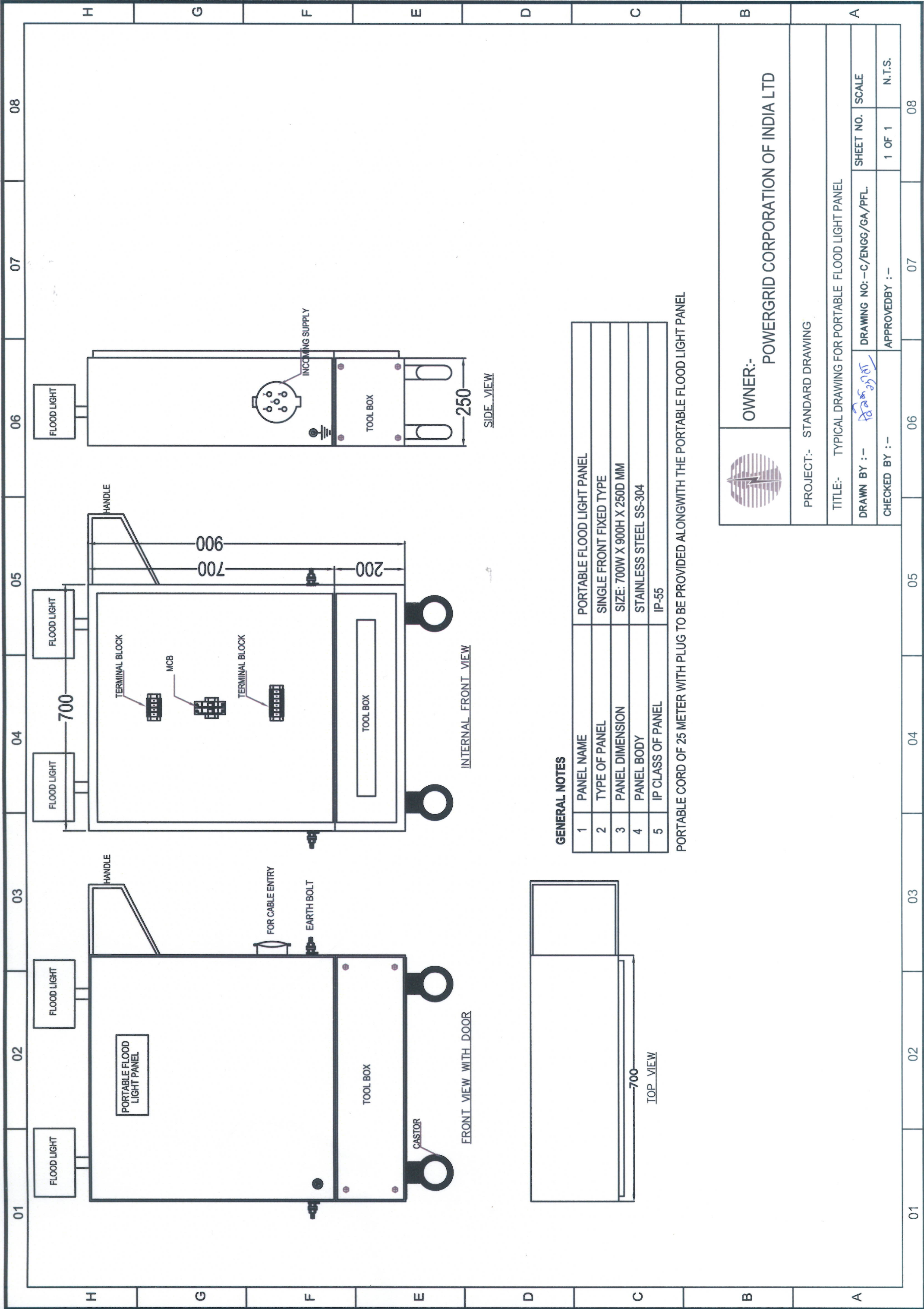
Project information Signage: The Signage shall be made up of rust free steel or equivalent materials of minimum size 3'x 2'. The Signage provide with detail of the project as approved by POWERGRID. The signage shall be prominently embossed.

Safety Signage: Safety Signage must be provided mentioning the level and type of voltage and symbols as per IE Rule at different position as may be required.

16.0 Provision for Module Cleaning

Plumbing: For cleaning of the PV Modules, plumbing work should be done in tune with the existing pipeline, so that water is easily available near the PV modules for cleaning the PV Modules.

Module Cleaning: Necessary equipment is to be provided to facilitate easy cleaning of the PV Modules.



GENERAL NOTES

1	PANEL NAME	PORTABLE FLOOD LIGHT PANEL
2	TYPE OF PANEL	SINGLE FRONT FIXED TYPE
3	PANEL DIMENSION	SIZE: 700W X 900H X 250D MM
4	PANEL BODY	STAINLESS STEEL SS-304
5	IP CLASS OF PANEL	IP-55

PORTABLE CORD OF 25 METER WITH PLUG TO BE PROVIDED ALONGWITH THE PORTABLE FLOOD LIGHT PANEL

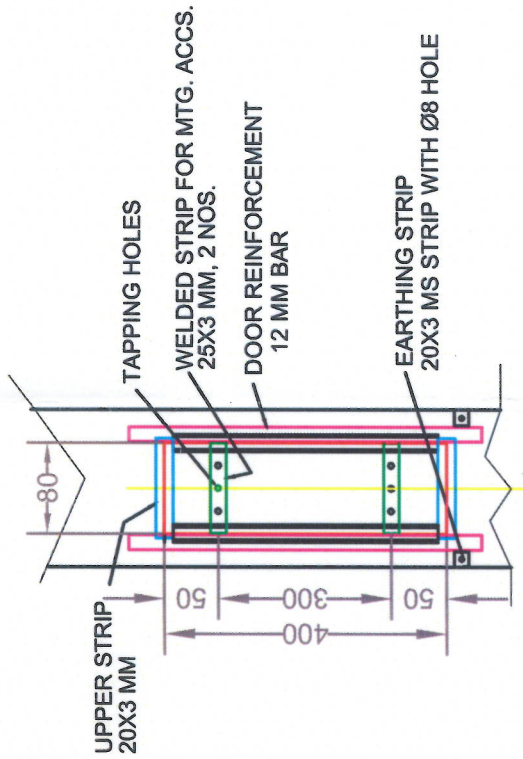
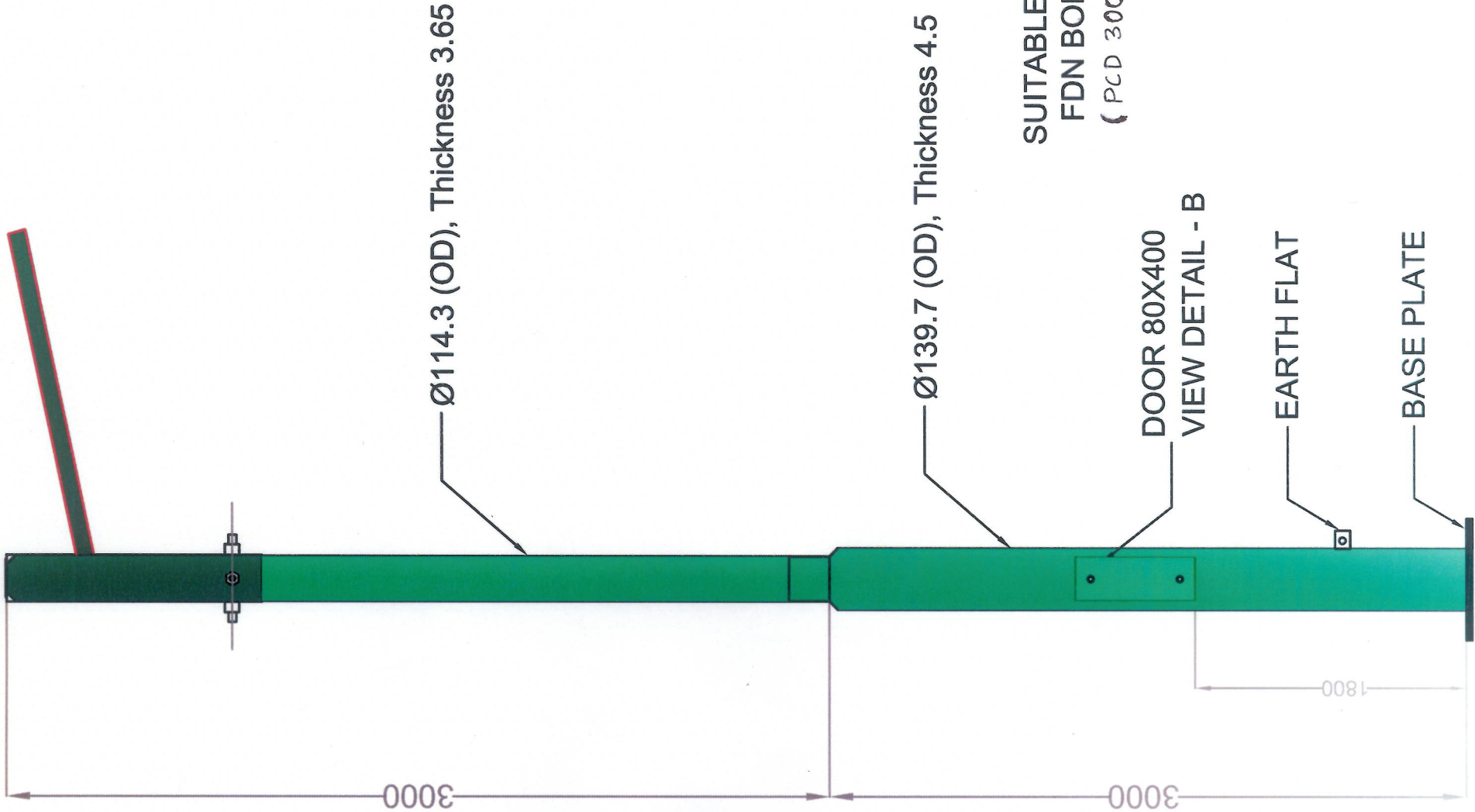


OWNER:- POWERGRID CORPORATION OF INDIA LTD

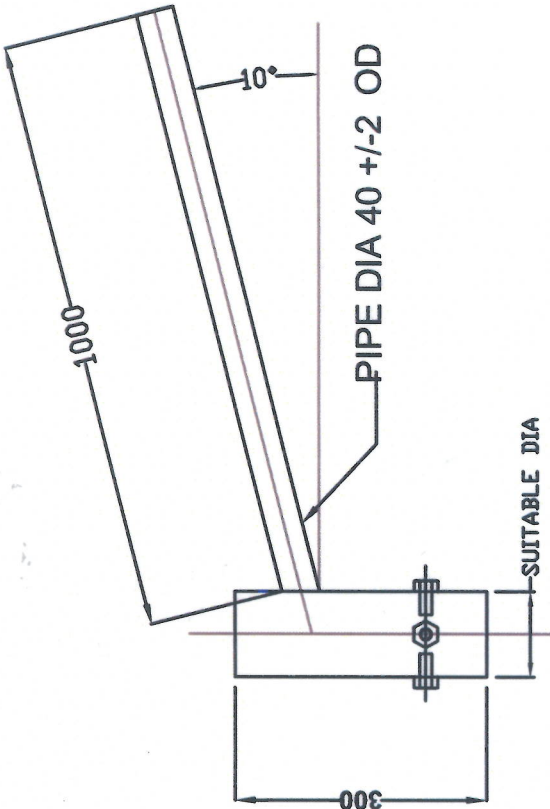
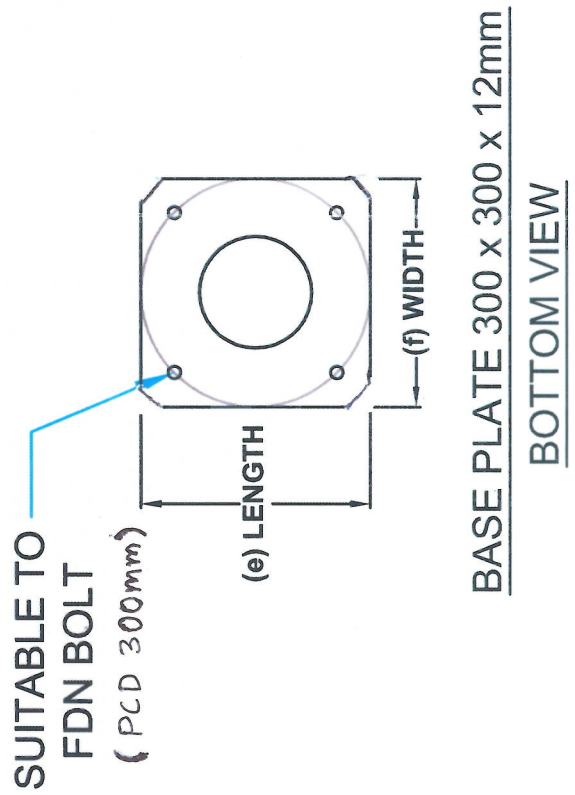
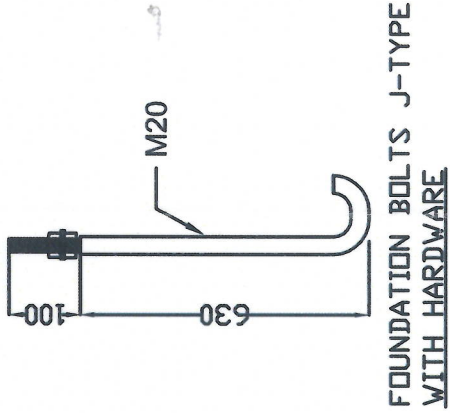
PROJECT:- STANDARD DRAWING

TITLE:- TYPICAL DRAWING FOR PORTABLE FLOOD LIGHT PANEL

DRAWN BY :-	DRAWING NO: -C/ENGG/GA/PFL.	SHEET NO.	SCALE
CHECKED BY :-	APPROVEDBY :-	1 OF 1	N.T.S.



DETAIL - B
(AFTER REMOVE DOOR COVER)

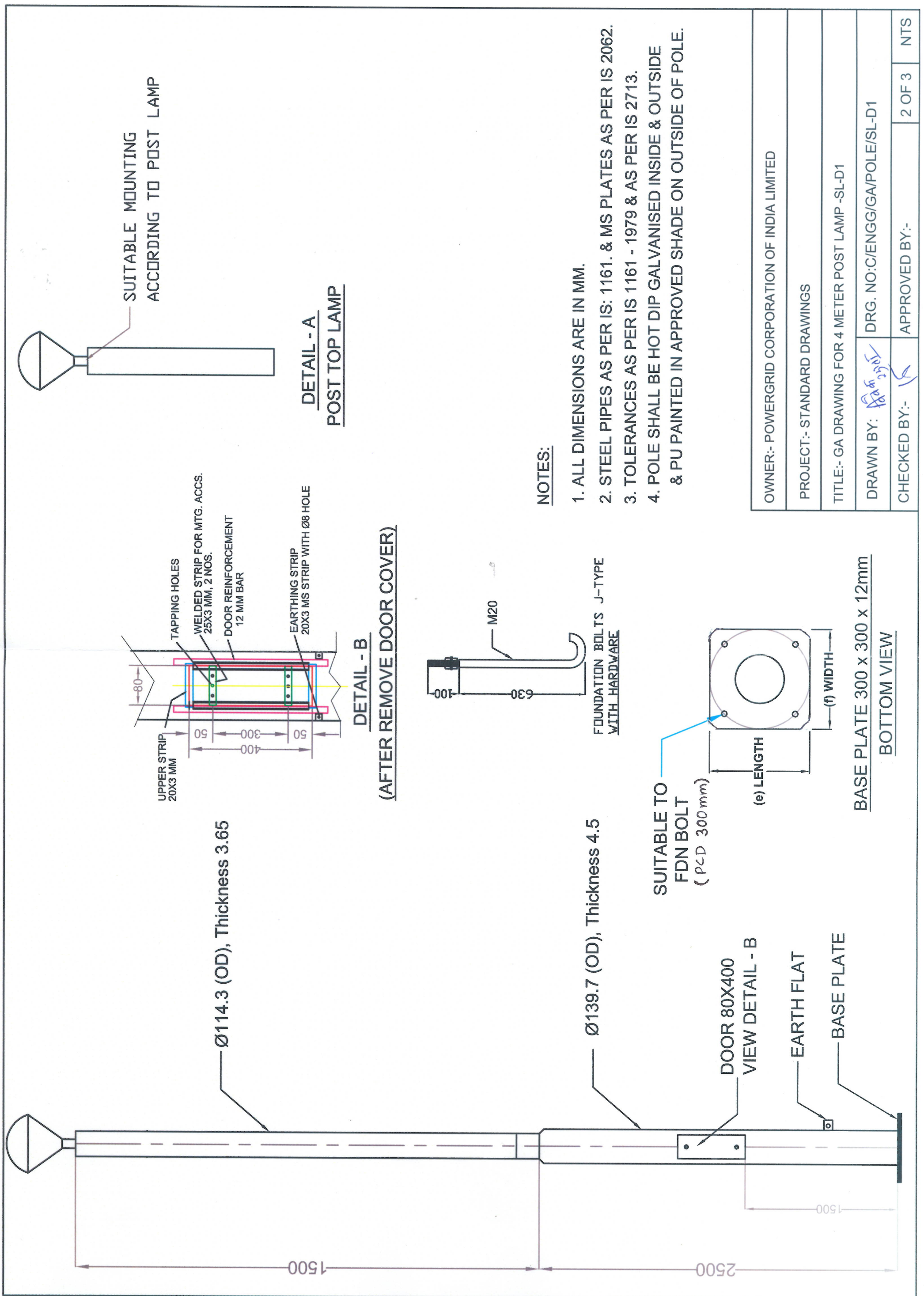


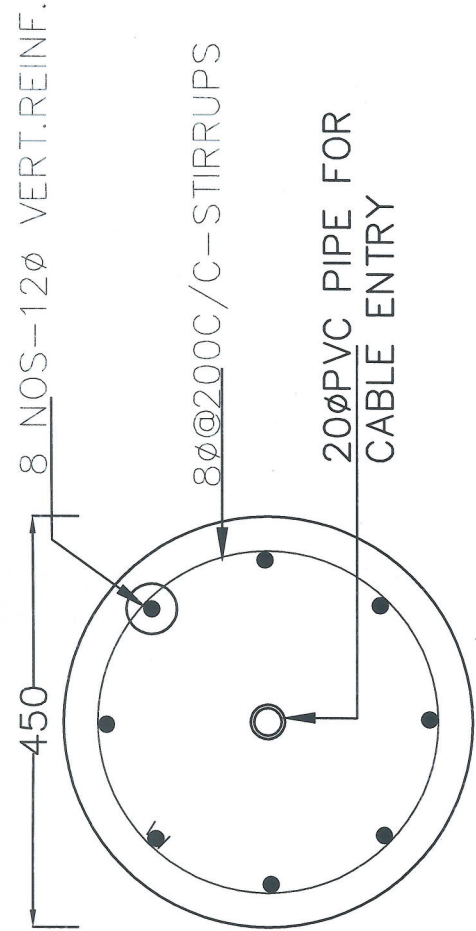
SINGLE ARM BRACKET

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. STEEL PIPES AS PER IS: 1161. & MS PLATES AS PER IS 2062.
3. TOLERANCES AS PER IS 1161 - 1979 & AS PER IS 2713.
4. POLE SHALL BE HOT DIP GALVANISED INSIDE & OUTSIDE
& PU PAINTED IN APPROVED SHADE ON OUTSIDE OF POLE.

OWNER:- POWERGRID CORPORATION OF INDIA LIMITED		
PROJECT:- STANDARD DRAWINGS		
TITLE:- GA DRAWING FOR 6 METER STEEL TUBULAR POLE-SL-L1		
DRAWN BY: <i>8/5/2015</i>	DRG. NO:C/ENGG/GA/POLE/SL-L1	
CHECKED BY: <i>16</i>	APPROVED BY:-	1 OF 3 NTS





SECTION: B-B

(A) GENERAL NOTES:

ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES
ONLY WRITTEN DIMENSIONS SHALL BE FOLLOWED. THE DRAWINGS SHALL NOT BE SCALED.
ALL STRUCTURAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ARCHITECTURAL
DISCREPANCY IN DRAWINGS IF ANY SHALL BE BROUGHT TO THE NOTICE OF THE
DESIGN OFFICE PRIOR TO CONSTRUCTION.
EXECUTION OF R.C.C. WORKS/STRUCTURAL STEEL WORK AS PER OUR DRAWINGS SHALL BE
THE RESPONSIBILITY OF SITE ENGINEER.

(B) SPECIFICATION NOTES FOR R.C.C WORK:

(GRADE OF CONCRETE)

CONCRETE FOR ALL WORKS AS PER BPS.

(REINFORCING STEEL)

ALL REINFORCING STEEL EXCEPT M.S LUGS FOR INSERT PLATES SHALL BE HIGH YIELD
STRENGTH DEFORMED BARS CONFORMING TO GRADE Fe 415. OR Fe 500 AS
LUGS FOR INSERT PLATES SHALL BE PLAIN M.S BARS CONFORMING TO GRADE 1 OF IS:432
(PART-1) 1966. IF FLATS OR ANGLES ARE USED AS LUGS, THEY SHALL CONFORM TO

(CLEAR COVER TO MAIN REINFORCEMENT)

UNLESS SHOWN OTHERWISE MIN. CLEAR COVER TO MAIN
REINFORCEMENT SHALL BE AS FOLLOWS
BOTTOM 40mm.
TOP, SIDES 40mm.

(LAP LENGTH OR DEVELOPMENT LENGTH FOR
DEFORMED BARS SHALL BE AS FOLLOWS)

-45xDIA OF BAR.

NOT MORE THAN 50% BARS SHALL BE SPLICED AT A SECTION.
(LOCATION OF SPLICE SHALL BE DECIDED IN CONSULTATION WITH SITE ENGINEER & PRIOR
APPROVAL OF DESIGN OFFICE).

IMP. NOTE: THIS DRAWING IS NOT APPLICABLE FOR MARSHY
LANDS

OWNER:- POWERGRID CORPORATION OF INDIA LIMITED

PROJECT:- STANDARD DRAWINGS

TITLE:- FOUNDATION DRAWING FOR POLE

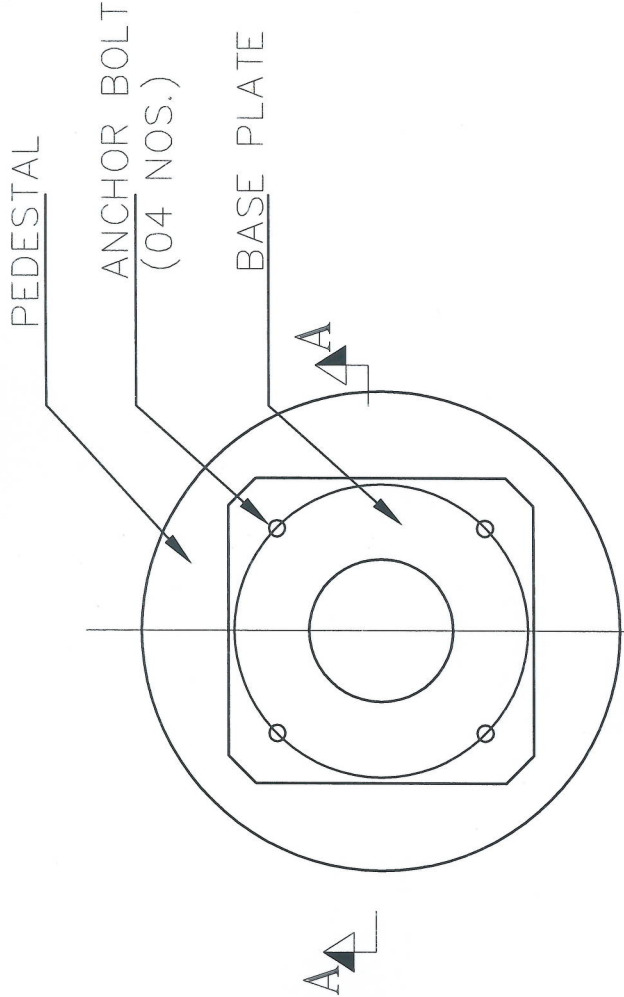
DRAWN BY:

DRG. NO: C/ENGG/FDN/POLE

CHECKED BY:-

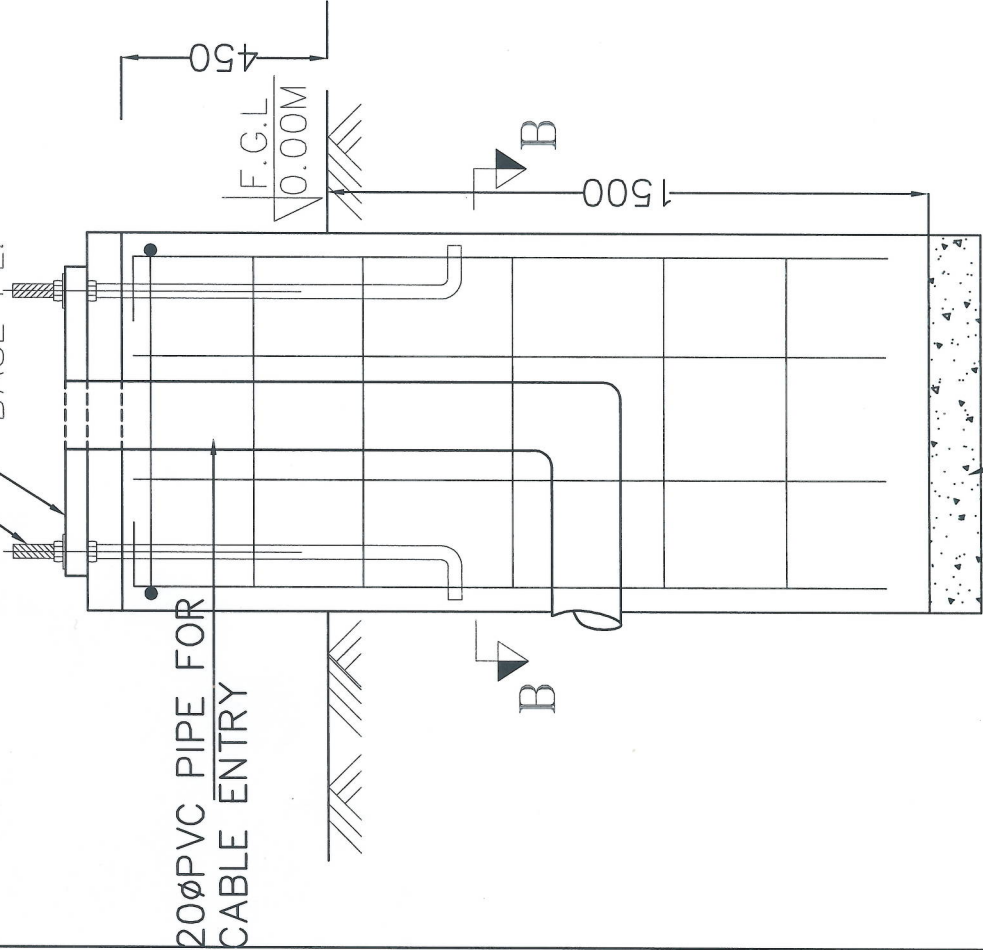
3 OF 3

NTS



PLAN

ANCHOR BOLT
REFER POLE DRAWING.
BASE PL.



P.C.C-1:4:8 75mm thk

SECTION: A-A

SECTION-3**PROJECT DETAILS & GENERAL SPECIFICATION****SITE INFORMATION**

	Particular	Details
a)	Owner	POWERGRID
b)	Customer	POWERGRID
c)	Project Title	Reactor Package RT-03 for 2x63MVAR, 3-Phase, 400kV Bus Reactor at 400/220kV Yelahanka S/S under System Strengthening in Southern Region-XXIII.
d)	Location	Yelahanka, near Bangalore in the state of Karnataka
e)	Transport Facilities	ROAD/TRAIN: Bangalore
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	Normal Pollution level
k)	Seismic Zone	As per the seismic zone defined in the relevant BIS / IEC-62271-300 but not less than 0.3g horizontal
WIND DATA		

	Wind velocity	As per IS
	Average No. of thunderstorm days per annum	As per IS
	Main Electrical Parameters:	
	Fault Levels:	50kA for 1 Sec
	Creepage Distance	25mm/kV

ENCLOSED – “**SECTION-GTR (GENERAL TECHNICAL REQUIREMENT) REV.14**”
FOR DETAILS OF GENERAL TECHNICAL SPECIFICATION.

PLEASE READ BHEL/PGCIL IN PLACE OF “EMPLOYER” MENTIONED ANYWHERE
IN SPECIFICATION.

SECTION- GENERAL TECHNICAL REQUIRMENT (GTR)

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Annexure- C1 Corona and Radio Interference Voltage (RIV) Test - 2 SHEET

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

1.0 FOREWORD

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

2.0 GENERAL REQUIREMENT

2.1 The contractor shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification during detailed engineering.

2.2 It is recognised that the Contractor may have standardised on the use of certain components, materials, processes or procedures different from those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to Employer.

2.3 Wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition.

2.4 Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components which are minor in nature and incidental to the requirement but not specifically stated in the specification and bid price schedule, which are necessary for commissioning and satisfactory operation of the switchyard/ substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment provided, shall be inter-changeable with one another.

~~2.5 The Contractor shall also be responsible for the overall co-ordination with internal /external agencies, Supplier of Employer's supplied equipments, project management, training of Employer's manpower, loading, unloading, handling, insurance, moving to final destination for successful erection, testing and commissioning of the substation /switchyard.~~

~~2.6 The bidder shall be responsible for safety of human and equipment during the working. It will be the responsibility of the Contractor to co-ordinate and obtain Electrical Inspector's clearance before commissioning. Any additional items, modification due to observation of such statutory authorities shall be provided by the Contractor at no extra cost to the Employer.~~

3.0 STANDARDS

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

3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the originally scheduled date of bid opening) of standard specified under Annexure-C of this section, unless specifically mentioned in the specification.

3.3 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

- 3.4 The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.
- 3.5 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
- 3.6 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards specified under Annexure-C/individual sections for various equipments shall also, be accepted, however the salient points of difference shall be clearly brought out during detailed engineering along with English language version of such standard. The equipment conforming to standards other than specified under Annexure-C/individual sections for various equipments shall be subject to Employer's approval.

SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

- 4.1 The 800kV and 420kV system is being designed to limit the switching surge over voltage of 1.9 p.u. and 2.5 p.u., respectively and the power frequency over voltage of 1.4 p.u. and 1.5 p.u., respectively. In case of the 420kV system, the initial value of the temporary overvoltages could be 2.0 p.u. for 1-2 cycles. The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc under such over voltage conditions.
- 4.2 All equipments shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.
- 4.3 All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.
- 4.4 The bidder shall design terminal connectors of the equipment taking into account various forces that are required to withstand.
- 4.5 The equipment shall also comply to the following:
- a) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".
 - b) All piping, if any between equipment control cabinet/operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

4.6 System Parameter

765kV, 400kV & 220kV System

SL No	Description of parameters	765kV System	400kV System	220kV System
1.	System operating voltage	765kV	400kV	220kV
2.	Maximum operating voltage of the system (rms)	800kV	420kV	245kV
3.	Rated frequency	50HZ	50Hz	50Hz
4.	No. of phase	3	3	3
5.	Rated Insulation levels			

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

SL No	Description of parameters	765kV System	400kV System	220kV System
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	2100kVp	1550kVp	1050 kVp
ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	1550kVp	1050kVp	-
iii)	One minute power frequency dry withstand voltage (rms)	830kV	630kV	-
iv)	One minute power frequency dry and wet withstand voltage (rms)	-	-	460kV
6.	Corona extinction voltage	508 kV	320kV	-
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz	2500 μV at 508 kV rms	1000 μV at 266kV rms	1000 μV at 156kV rms
8.	Minimum creepage distance - for Equipment other than Insulator string	20000 mm (24800 mm for coastal area)	10500 mm (13020 mm for coastal area)	6125 mm (7595 mm for coastal area)
	Minimum creepage distance - for Insulator String	As specified in Section-Switchyard Erection		
9.	Min. clearances			
i.	Phase to phase	7600mm (for conductor-conductor configuration) 9400mm (for rod-conductor configuration)	4000mm (for conductor-conductor configuration) 4200mm (for rod -conductor configuration)	2100 mm
ii.	Phase to earth	4900mm (for conductor-structure) 6400mm (for rod- structure)	3500 mm	2100 mm
iii)	Sectional clearances	10300 mm	6500 mm	5000 mm
10.	Rated short circuit current for 1 sec. duration	40kA/50kA (as applicable)	40kA/ 50kA/ 63 kA (as applicable)	40kA/ 50kA(as applicable)
11.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed

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132kV, 66kV, 33kV & 11kV System

SL No	Description of parameters	132 kV System	66kV System	33 kV System	11kV System
1.	System operating voltage	132kV	66kV	33kV	11kV
2.	Maximum operating voltage of the system(rms)	145kV	72.5kV	36kV	12kV
3.	Rated frequency	50Hz	50Hz	50Hz	50Hz
4.	No. of phase	3	3	3	3
5.	Rated Insulation levels				
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	650 kVp	325 kVp	170 kVp	75 kVp
ii)	One minute power frequency dry and wet withstand voltage (rms)	275kV	140kV	70kV	28kV
6.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz	500 μ V at 92kV rms	-	-	-
7.	Minimum creepage distance	3625 mm (4495mm for coastal area)	1813 mm (2248mm for coastal area)	900 mm (1116mm for coastal area)	300 mm (372mm for coastal area)
8.	Min. clearances				
i.	Phase to phase	1300 mm	750 mm	320 mm	280 mm
ii.	Phase to earth	1300 mm	630 mm	320 mm	140 mm
iii.	Sectional clearances	4000 mm	3000 mm	2800 mm	2800 mm
9.	Rated short circuit current	40kA/ 31.5 kA (as applicable) for 1 sec	31.5 kA for 3 sec	25 kA for 3 sec	25 kA for 3 sec
10.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed	Effectively earthed

Notes:

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

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5.0 ENGINEERING DATA AND DRAWINGS

5.1 The list of drawings/documents which are to be submitted to the Employer is enclosed in **Annexure-E**. In case any additional drawings/documents are required, the same shall also be submitted during execution of the contract.

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 Employer. 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 Employer, the unit designation, the specifications title, the specification number and the name of the Project. POWERGRID has standardized a large number of drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings 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 Employer will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Employer may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Employer shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

5.5 All manufacturing and fabrication work in connection with the equipment prior to the 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 Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

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

5.7 Approval Procedure

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

- | | | |
|----|--|--------------------|
| i) | Approval/comments/
by Employer on initial
submission | As per L2 schedule |
|----|--|--------------------|

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ii)	Resubmission (whenever required)	Within 3 (three) weeks from date of comments
iii)	Approval or comments	Within 3 (three) weeks of receipt of resubmission.
iv)	Furnishing of distribution copies (2 hard copies to each substation and one scanned copy (pdf format)	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 to each substation plus 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/ operation manuals (2 copies per substation and one softcopy (pdf format) for corporate centre & per substation)	On completion of Engineering
vii)	As built drawings (two sets of hardcopy per substation & one softcopy (pdf format) for corporate centre & per substation)	On completion of entire works

NOTE :

- (1) The contractor may please note that all resubmissions must incorporate all comments given in the earlier submission by the Employer or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.
- (2) All drawings should be submitted in softcopy form, however substation design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version. SLD, GA & layout drawings shall be submitted for the entire substation in case of substation extension also.
- (3) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.
- (4) If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer.
- (5) The Contractor shall furnish to the Employer catalogues of spare parts.
- (6) All As-built drawings/documents shall be certified by site indicating the changes before final submission.

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- 5.8 The list of major drawings/documents to be approved to qualify for second advance as per Section SCC, shall be as per **Annexure-D**.

6.0 MATERIAL/ WORKMANSHIP

6.1 General Requirement

- 6.1.1 Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.
- 6.1.2 In case where the equipment, materials or components are indicated in the specification as “similar” to any special standard, the Employer shall decide upon the question of similarity. When required by the specification or when required by the Employer the 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 is to be understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.
- 6.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Employer.
- 6.1.4 Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.
- 6.1.5 All materials and equipment shall be installed in strict accordance with the manufacturer’s recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, levelling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer’s tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer’s limits suitable guards shall be provided for the protection of personnel on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.
- 6.1.6 The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him.

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- 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. If such is the case, he shall declare in the proposal, where such oil or grease is available. He shall help Employer in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

6.2 Provisions For Exposure to Hot and Humid climate

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

6.2.1 Space Heaters

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

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

6.2.2 FUNGI STATIC VARNISH

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

6.2.3 Ventilation opening

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

6.2.4 Degree of Protection

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

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

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

6.3 RATING PLATES, NAME PLATES AND LABELS

- 6.3.1 Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial

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number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Employer. The rating plate of each equipment shall be according to IEC requirement.

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

6.4 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

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

7.0 DESIGN IMPROVEMENTS / COORDINATION

- 7.1 The bidder shall offer the equipment meeting the requirement of the technical specification. However, the Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the contractor & Employer agree upon any such changes, the specification shall be modified accordingly.
- 7.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.
- 7.3 The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.
- 7.4 The Contractor has to coordinate designs and terminations with the agencies (if any) who are Consultants/Contractor for the Employer. The names of agencies shall be intimated to the successful bidders.
- 7.5 The Contractor will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the Consultants of the Employer (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 Contractor's Works or at his Sub-Contractor's premises or at the Employer's site or at any other place of Work as applicable, are in accordance with the specifications, the Contractor shall ensure suitable quality assurance programme to control such activities at all points necessary. A quality assurance programme of the Contractor shall be in line with ISO requirements & shall generally cover the following:
- a) The organisation structure for the management and implementation of the proposed quality assurance programme.

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- b) System for Document and Data Control.
- c) Qualification and Experience data of Bidder's key personnel.
- d) The procedure for purchases of materials, parts, components and selection of sub-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, fabrication and assembly control.
- f) System for Control of non-conforming products including deviation dispositioning, if any and system for corrective and preventive actions based on the feedback received from the Customers and also internally documented system for Customer complaints.
- g) Inspection and test procedure both for manufacture and field activities.
- h) System for Control of calibration of testing and measuring equipment and the indication of calibration status on the instruments.
- i) System for indication and appraisal of inspection status.
- j) System of Internal Quality Audits, Management review and initiation of corrective and Preventive actions based on the above.
- k) System for authorising release of manufactured product to the Employer.
- l) System for maintenance of records.
- m) System for handling, storage and delivery.
- n) A quality plan detailing out the specific quality control measures and procedure adopted for controlling the quality characteristics relevant to each item of equipment furnished and /or service rendered.
- o) System for various field activities i.e. unloading, receipt at site, proper storage, erection, testing and commissioning of various equipment and maintenance of records. In this regard, the Employer has already prepared Standard Field Quality Plan for transmission line/substation equipments as applicable, Civil/erection Works which is required to be followed for associated works.

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

8.2 Quality Assurance Documents

The Contractor shall ensure availability of the following Quality Assurance Documents:

- i) All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication, and reports including radiography interpretation reports.
- ii) Welder and welding operator qualification certificates.
- iii) Welder's identification list, welding operator's qualification procedure and welding identification symbols.
- iv) Raw Material test reports on components as specified by the specification and in the quality plan.

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- v) The Manufacturing Quality Plan(MQP) indicating Customer Inspection Points (CIPs) at various stages of manufacturing and methods used to verify that the inspection and testing points in the quality plan were performed satisfactorily.
- vi) Factory test results for testing required as per applicable quality plan/technical specifications/GTP/Drawings etc.
- vii) Stress relief time temperature charts/oil impregnation time temperature charts, wherever applicable.

8.3 INSPECTION, TESTING & INSPECTION CERTIFICATE

8.3.1 Contractor shall procure bought out items from sub-vendors as per the list in "Compendium of Vendors" available on POWERGRID web-site www.powergridindia.com after ensuring compliance to the requirements/conditions mentioned therein. Contractor shall explore first the possibilities of procuring the bought out items from POWERGRID approved existing vendors. In case of their unavailability / non-response, Contractor may approach POWERGRID for additional sub-vendor approval. In that case, the assessment report of proposed sub vendor by Contractor along with the enclosures as per **Annexure-F** shall be submitted within 60 days of the award. The proposal shall be reviewed and approval will be accorded based on the verification of the document submitted and/or after the physical assessment of the works as the case may be. The physical assessment conducted by POWERGRID, if required, shall be on chargeable basis. Charges shall be as per the POWERGRID norms prevailing at that time, which shall be intimated by POWERGRID separately. If proposal for sub-vendor is submitted after 60 days, the Contractor's proposal normally will not be considered for current LOA. However, POWERGRID may process the case for developing more vendors for referred items, if found relevant. In all cases, It is the responsibility of the Contractor that Project activities do not suffer on account of delay in approval/non approval of a new sub-vendor.

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

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

Items not covered under MQP/ITP/FAT shall be offered for inspection as per POWERGRID LOA/technical Specifications/POWERGRID approved data sheets/ POWERGRID approved drawings and relevant Indian/International standards.

Inspection Levels: For implementation of projects in a time bound manner and to avoid any delay in deputation of POWERGRID or its authorized representative, involvement of POWERGRID for inspection of various items / equipment will be based on the level below:

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

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- Level – II:** Contractor to raise all inspection calls and carry out the inspection on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during inspection, the same would be intimated to Contractor and CIP/MICC will be issued by POWERGRID. Else, Contractor would submit their test reports/certificates to POWERGRID. CIP/MICC will be issued by POWERGRID based on review of test reports/certificates.
- Level - III:** Contractor to raise inspection calls for both, stage (as applicable) & final inspection and carry out the stage inspections (if applicable) on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during stage inspection, the same would be intimated to Contractor and CIP will be issued by POWERGRID. Else, Contractor would submit the test reports / certificates of stage inspection after their own review and CIP will be issued by POWERGRID based on review of test reports / certificates. Final inspection will be carried out by POWERGRID and CIP/MICC will be issued by POWERGRID.
- Level – IV:** Contractor to raise inspection calls for both, stage (as applicable) & final inspections. POWERGRID will carry out the inspection for both stage & final inspection as per applicable standards/specification and CIP/MICC will be issued by POWERGRID.
- 8.3.2 Contractor shall ensure that to implement the above inspection levels, particularly for the quality control and inspection at sub-vendor's works, they would depute sufficient qualified & experienced manpower in their Quality Control and Inspection department. Further, to assure quality of construction, Contractor shall have a separate workforce having appropriate qualification & experience and deploy suitable tools and plant for maintaining quality requirement during construction in line with applicable Field Quality Plan (FQP).
- 8.3.3 The Employer, his duly authorised representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times access to the Contractor's premises or Works and shall have the power at all reasonable times to ensure that proper Quality Management practices / norms are adhered to, inspect and examine the materials & workmanship of the Works, to carry out Quality/Surveillance Audit during manufacture or erection and if part of the Works is being manufactured or assembled at other premises or works. The Contractor shall obtain for the Employer 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. The item/equipment, if found unsatisfactory with respect to workmanship or material is liable to be rejected. The observations for improvements during product/ process inspection by POWERGRID shall be recorded in Quality Improvement Register (available & maintained at works) for review & timely compliance of observations.
- 8.3.4 Contractor shall submit inspection calls over internet through POWERGRID website. The required vendor code and password to enable raising inspection call will be furnished to the main Contractor within 30 days of award of contract on submission of documents by Contractor. After raising the inspection calls, Contractor shall then proceed as per the message of that particular call which is available on the message board.
- 8.3.5 The Employer reserves the right to witness any or all type, acceptance and routine tests specified for which the Contractor shall give the Employer/Inspector Twenty one (21) days written notice of any material being ready for testing for each stage of

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testing as identified in the approved quality plan as customer inspection point(CIP) for indigenous inspections. All inspection calls for overseas material shall be given at least forty five (45) days in advance. Such tests shall be to the Contractor's account except for the expenses of the Inspection Engineer. The Employer/inspector, unless witnessing of the tests is waived by Employer, will attend such tests within Twenty one (21) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector three copies of tests, duly certified. Contractor shall ensure, before giving notice for type test, that all drawings and quality plans have been got approved. The equipment shall be dispatched to site only after approval of Routine and Acceptance test results and Issuance of Dispatch Clearance in writing by the Employer. CIP/Material Inspection clearance certificate (MICC) shall be issued by the Employer after inspection of the equipment or review of test reports as applicable. Employer may waive off the presence of Employer's inspecting engineer. In that case test will be carried out as per approved QP and test certificate will be furnished by the supplier for approval. CIP/MICC will be issued only after review and approval of the test reports.

- 8.3.6 Contractor shall generally offer material for inspection as per supply bar chart approved by POWERGRID and not before 30 days from schedule indicated in the bar chart. In case Contractor offers material(s) for inspection prior to 30 days from the scheduled date with necessary approval of POWERGRID, POWERGRID shall inspect the material and issue CIP only. However, in such an exceptional case, MICC shall be issued only as per provision of original / revised approved supply schedule.
- 8.3.7 Contractor shall minimize the number of inspection calls by offering optimum quantities in each inspection call at the respective manufacturer's works.
- 8.3.8 Contractor shall inspect the material themselves and only after they are fully convinced about the Quality, they shall offer the material for POWERGRID inspection and shall also ensure that relevant portion of LOA/NOA, approved drawing and data sheets along with applicable Quality Plans are available at the works of Contractor or their Sub-vendor before the material is offered for inspection.
- 8.3.9 Contractor shall ensure that material which has been cleared for dispatch after inspection will be dispatched within 30 days in case of domestic supplies and within 60 days in case of Off-shore supplies from the date of issuance of CIP. Material which is not dispatched within stipulated time as above will be reoffered for POWERGRID inspection or specific approval of POWERGRID QA&I shall be obtained for delayed dispatch.
- 8.3.10 The Employer or IE shall give notice in writing to the Contractor, of any objection either to conformance to any drawings or to any equipment and workmanship which in his opinion is not in accordance with the Contract. The 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 Employer/Inspection Engineer giving reasons therein, that no modifications are necessary to comply with the Contract.
- 8.3.11 All Test Reports and documents to be submitted in English during final inspection of equipment by POWERGRID or as and when required for submission.
- 8.3.12 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Employer/Inspection Engineer(IE) shall issue a certificate to this effect within fifteen (15) days after completion of tests & submission of documents by Contractor/manufacturer but if the tests are not witnessed by the Employer/IE, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Employer/IE. Contractor shall, on completion of all tests, submit test

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reports within Ten (10) days to POWERGRID IE. Failure of the Employer/IE 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 Employer to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract.

- 8.3.13 In all cases, where the Contract provides for tests whether at the premises or works of the 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 Employer/Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Employer/Inspection Engineer or to his authorised representative to accomplish testing.
- 8.3.14 The inspection and acceptance by Employer and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract, or if such equipment is found to be defective at a later stage.
- 8.3.15 The Employer will have the right of having at his own expenses any other test(s) of reasonable nature carried out at 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.
- 8.3.16 The Employer reserves the right for getting any additional field tests conducted on the completely assembled equipment at site to satisfy that material complies with specifications.
- 8.3.17 Rework/ Re-engineering, if any, on any item/equipment shall be carried out only after mutual discussions and in accordance with mutually agreed procedure. Contractor shall submit Joint Inspection Report of equipments under Re-Work/Re-Engineering alongwith procedure for the same to POWERGRID for approval, before taking up the Re-Work/Re-Engineering, failing which POWERGRID reserves the right to reject the equipment.
- 8.3.18 Contractor may establish a field test Laboratory to execute Civil Construction testing requirements at site with the condition that all testing equipment shall be calibrated from POWERGRID approved accredited Testing laboratories, with calibration certificates kept available at site and all testing personnel employed in the Field Testing Laboratories to be qualified and experienced Engineers or testing to be carried out at POWERGRID approved Third Party Laboratories.
- 8.3.19 Contractor shall ensure that all possible steps are taken to avoid damages to the equipment during transport, storage and erection.
- 8.3.20 Contractor shall implement additional stringent quality checks and preparation during installation of GIS at site (if applicable) as per POWERGRID approved guidelines/Technical specifications.
- 8.3.21 Contractor shall ensure commissioning of all CSDs along with Circuit Breakers wherever applicable.
- 8.3.22 For EHV transformers/reactors:**
- Insulation oil shall be as per POWERGRID Technical specifications and same grade shall be used for impregnation of the active part & testing at the works of Transformer/Reactor Manufacturer and as well as for filling the Transformer/Reactors at site. Contractor to ensure that windings for Transformer/Reactors are made in air-conditioned environment. Core-coil assembly shall be performed in positive

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

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

9.0 TYPE TESTING & CLEARANCE CERTIFICATE

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

- 9.2 The reports for all type tests as per technical specification shall be furnished by the Contractor alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all projects with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by POWERGRID or representative authorized by POWERGRID or Utility or representative of accredited test lab.

Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted within last 10 (ten) years from the date of NOA. In case the test reports are of the test conducted earlier than 10 (ten) years from the date of NOA, the contractor shall repeat these test(s) at no extra cost to the Employer.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Employer.

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

- 9.3 The Employer intends to repeat those type tests which are indicated in the price schedule and the same shall be payable as per provision of contract. The price of conducting type tests shall be included in Bid price and break up of these shall be given in the relevant schedule of Bid Proposal Sheets. These Type test charges would be considered in bid evaluation. In case Bidder does not indicate charges for any of the type tests or does not mention the name of any test in the price schedules, it will be presumed that the particular test has been offered free of charge. Further, in case any Bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected. The Employer reserves the right to waive the repeating of type tests partly or fully and in case of waiver, test charges for the same shall not be payable.

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9.4 The Employer reserves the right to witness any or all the type tests. The Employer shall bear all expenses for deputation of Employer's representative(s) for witnessing the type tests.

9.5 The list of makes of various items, for which Type test reports are not required to be submitted are specified in Compendium of Vendors (COV).

10.0 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 Employer 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 Employer 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 arranged by the Contractor at his own cost.

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

10.3.4 PRECOMMISSIONING, COMMISSIONING, TRIAL-RUN & COMPLETION

As soon as the Facilities covered by these specifications are physically completed in all respects, the Pre commissioning, Commissioning, Trial-run and Completion of the Facilities, as mentioned below, shall be attained in accordance with the procedure given in the Conditions of Contract, Vol.-I of the Bidding Documents.

- (i) Pre commissioning : As per relevant Sections
- (ii) Commissioning : Charging of the Facilities at rated voltage.

Further, wherever appearing in these specifications, the words-'commissioning checks', 'installation checks', 'site tests', 'performance guarantee tests for fire protection system', are to be considered as 'pre commissioning checks'.

- (iii) Trial-run : Operation of the Facilities or any part thereof by the Contractor immediately after the Commissioning for a continuous period of 72 (Seventy two) hours continuously. In case of interruption due to problem/failure in the respective equipment, the contractor shall rectify the problem and after rectification, continuous 72 (Seventy two) hours period start after such rectification.
- (iv) Completion : Upon successful completion of Trial-run.

'Guarantee Test(s)' and/or 'Functional Guarantees' are applicable only for Substation Automation System as specified in Section-'Substation Automation System.'

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.

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11.0 PACKAGING & PROTECTION

- 11.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Employer, the Contractor shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Employer to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The 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. Employer takes no responsibility of the availability of the wagons.
- 11.2 All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

12.0 FINISHING OF METAL SURFACES

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

12.2 HOT DIP GALVANISING

- 12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above **and 900 gm/sq.m for coastal area (30km from sea shore approximately) or as specified in Section-Project**. 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 **and 900 gm/sq.m for coastal area as specified in Section-Project**.
- 12.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- 12.2.3 After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate or alternate approved treatment shall be provided to avoid formation of white rust after hot dip galvanization.
- 12.2.4 The galvanized steel shall be subjected to four numbers of one minute dips in copper sulphate solution as per IS-2633.
- 12.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.
- Coating thickness
 - Uniformity of zinc

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- Adhesion test
- Mass of zinc coating

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

12.3 PAINTING

12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

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

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

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

12.3.5 In case the contractor proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted during detailed engineering for Employer's review & approval.

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
<u>Fire Protection System</u>			
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	
<u>Air Conditioning Plant</u>			
5	Refrigerant gas pipeline – at compressor suction	Canary Yellow	-

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S.No.	PIPE LINE	Base colour	Band colour
6	Refrigerant gas pipeline – at compressor discharge	Canary Yellow	Red
7	Refrigerant liquid pipeline	Dark Admiralty Green	-
8	Chilled water pipeline	Sea Green	-
9	Condenser water pipeline	Sea Green	Dark Blue

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



Base Colour Direction of flow Band Colour

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

13.0 HANDLING, STORING AND INSTALLATION

- 13.1 In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Employer 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 must ensure that the open storage platform (as per Drawing No. C-ENGG-CVL-STD-PLATFORM-01, Rev.0) is constructed for storage of outdoor type equipment/material prior to commencement of delivery at site. Outdoor equipment shall be stored on open storage platform, properly covered with waterproof and dustproof covers to protect them from water seepage and moisture ingress.
- However, all indoor equipments including control & protection panels, Communication equipments and operating mechanism boxes etc. of outdoor equipments shall be stored indoors.
- Storage of equipment on top of another one is not permitted if the wooden packing is used and there is possibility of equipment/packing damage. 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 Employer. 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

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for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.

- 13.6 Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer 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 Contractor shall be fully responsible for the equipment/material until the same is handed over to the Employer 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 Employer, as well as protection of the same against theft, element of nature, corrosion, damages etc.
- 13.8 Where material / equipment is unloaded by Employer before the Contractor arrives at site or even when he is at site, Employer 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 The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances the Contractor shall immediately proceed to correct the discrepancy at his risks and cost.

13.13 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 Employer. 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

14.1 TOOLS & PLANTS (T&P)

The Contractor shall arrange all T&P (such as necessary supports, cranes, ladders, platforms etc.) for erection, testing & commissioning of the system at his own cost. Further, all consumables, wastage and damages shall be to the account of contractor.

All such T&P shall be taken back by the contractor after commissioning of the system.

14.2 SPECIAL TOOLS AND TACKLES

The contractor shall supply all special tools and tackles required for Operation and maintenance of equipment. The special tools and tackles shall only cover items which

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are specifically required for the equipment offered and are proprietary in nature. The list of special tools and tackles, if any, shall be finalized during detail engineering and the same shall be supplied without any additional cost implication to the Employer.

14.3 FACILITIES TO BE PROVIDED BY THE EMPLOYER

14.3.1 Employer shall make available the auxiliary supplies at a single point in the substation on chargeable basis. The prevailing energy rates of the state shall be applicable. All further distribution from the same for construction supply shall be made by the contractor. However, in case of failure of power due to any unavoidable circumstances, the contractor shall make his own necessary arrangements like diesel generator sets etc. at his own cost so that progress of work is not affected and Employer shall in no case be responsible for any delay in works because of non-availability of power.

14.3.2 Employer shall make available construction water supply at a single point in the substation. All further distribution for the same shall be made by the Contractor. In case of non-availability or inadequate availability of water for construction work, the contractor shall make his own arrangement at his own cost and the Employer shall in no case be responsible for any delay in works because of non-availability or inadequate availability of water.

15.0 AUXILIARY SUPPLY

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

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/Wire	Neutral connection
415V	$\pm 10\%$	$50 \pm 5\%$	3/4 Wire	Solidly Earthed.
240V	$\pm 10\%$	$50 \pm 5\%$	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	Isolated 2 wire System	-
110V	95V to 120V	DC	Isolated 2 wire System	-
48V	--	DC	2 wire system (+) earthed	-

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

16.0 SUPPORT STRUCTURE

16.1 The equipment support structures shall be suitable for equipment connections at the first level i.e 14.0 meter, 8.0 meter, 5.9 meter and 4.6 meter from plinth level for 765kV, 400kV, 220kV and 132kV substations respectively. All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.

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

17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

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- 17.1 All power clamps and connectors shall conform to IS:5561 or other equivalent international standard and shall be made of materials listed below :

Sl. No.	Description	Materials
a)	For connecting ACSR conductors/AAC conductors/ Aluminium tube	Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617
b)	For connecting equipment terminals mad of copper with ACSR conductors/AAC conductors/ Aluminium tube	Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS:617 with 2mm thick bimetallic liner/strip and all test shall conform to IS:617
c)	For connecting G.I	Galvanised mild steel shield wire
d)	Bolts, nuts & plain washers	Electro-galvanised for sizes below M12, for others hot dip galvanised.
e)	Spring washers	Electro-galvanised mild 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. 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 all equipment as specified in each particular case, are also included in the scope of Work.
- 17.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner/strip of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-metallic liner/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 IPS AL tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.
- 17.8 Current carrying parts (500A and above) of the clamp/connector shall be provided with minimum four numbers of bolts preferably for 132kV & above.
- 17.9 All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 17.10 Power Clamps and connectors shall be designed to control corona as per requirement.

17.11 Tests

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

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approval. Type test once conducted shall hold good. 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) [for 400kV and above] and RIV (dry) test [for 132kV 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 stainless steel of atleast 1.5 mm thick or aluminum enclosure of atleast 1.6 mm thick and shall be dust, water and vermin proof. Stainless steel used shall be of grade SS304 (SS316 for coastal area) or better. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of 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 in marshalling boxes / Control cabinets to prevent ingress of rain water.

18.4 Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere.

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

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

18.6 All boxes/cabinets shall be designed for the entry of cables by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, 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.

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- 18.8 LED based illumination of minimum 9 watts shall be provided. The switching of the fittings shall be controlled by the door switch.
- For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.
- 18.9 All control switches shall be of MCB/rotary switch type and Toggle/piano switches shall not be accepted.
- 18.10 Earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.
- 18.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/feruling by pasting the same on the inside of the door.
- 18.12 The following routine tests alongwith the routine tests as per IS:5039 shall also be conducted:
- i) Check for wiring
 - ii) Visual and dimension check
- 18.13 The enclosure of bay marshalling kiosk, junction box, terminal box and control cabinets shall conform to IP-55 as per IS:13947 including application of 2KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test.
- 19.0 DISPOSAL OF PACKING MATERIAL & WASTE FROM CONSTRUCTION SITE**
- After completion of the work, Contractor shall dispose-off all the packing & waste materials including empty conductor drums, cable drums, wooden containers, oil drums, gas cylinders and other waste/scrapped materials from construction site at his own cost and shall make the substation area properly cleaned.
- 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 the terminal blocks shall be non-disconnecting stud type except for the secondary junction boxes of Current Transformer and Voltage Transformer.
- 20.3 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.
- 20.4 The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.
- 20.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.
- 20.6 The terminal blocks shall be of extensible design, multilayer terminal arrangement is not allowed in any junction box (Common MB, Individual MB, JB etc.). There should be

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- sufficient space at both sides of terminals so that ferrule number of wires / TB numbers are clearly visible during wire removal or insertion.
- 20.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 20.8 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.
- 20.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.
- | | | |
|----|------------------------------------|---|
| a) | All circuits except 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 Contractor shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets. For equipments rated for 400 kV and above the wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge overvoltages either transferred through the equipment or due to transients induced from the EHV circuits.
- 20.14 All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Contractor shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.
- 21.0 LAMPS & SOCKETS**
- 21.1 Lamps & Sockets**
- All lamps shall use a socket base as per IS-1258, except in the case of signal lamps.
- All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.
- 21.2 Hand Lamp:**
- A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.
- 21.3 Switches and Fuses:**
- 21.3.1 Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker / switch fuse units. Selection of the main and Sub-circuit fuse

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

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.

~~22.9 RTV Coating on porcelain insulators (for coastal area)~~

~~RTV coating shall be done at site on all porcelain insulators (i.e. bushings, hollow and solid insulators, disc insulators etc.) for substation(s) in coastal area as defined elsewhere. The cost of RTV coating shall be deemed to be included in the respective~~

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~~equipment/items' erection cost. The technical details of RTV coating is attached in Annexure H.~~

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

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

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.

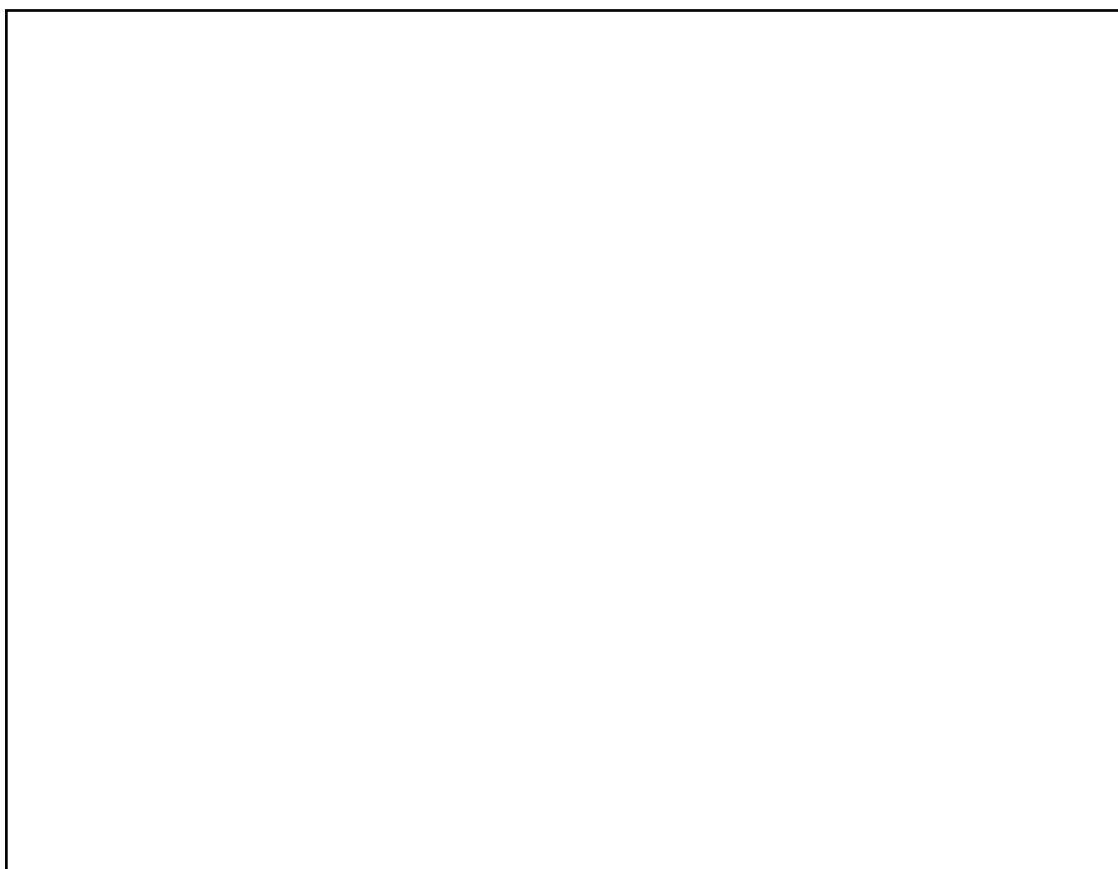
23.5 TESTING AND COMMISSIONING

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 Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Employer for approval.

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

24.

24.1



SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**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 carried out in accordance with relevant IEC of respective equipment or NEMA standard Publication No. 107-1964.

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

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

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

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

4. Test Methods for Visible Corona

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

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

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

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

- 4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.
- 4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Employer's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.
- 4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.
- 4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Employer's inspector if, in his opinion, it will not prejudice other test.

5. Test Records:

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

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

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**ANNEXURE-B****SEISMIC WITHSTAND TEST PROCEDURE**

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

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

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

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

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

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

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

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

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

CODES	TITLE
ANSI-CG,IEEE-4	Standard Techniques for High Voltage Testing
IEC 60076	Power transformers
IEC 60076-1	Part 1: General
IEC 60076-2	Part 2: Temperature rise
IEC 60076-3	Part 3: Insulation levels, dielectric tests and external clearances in air
IEC 60076-4	Part 4: Guide to the lightning impulse and switching impulse testing - Power transformers and reactors
IEC 60076-3-1	Part 3-1: Insulation Levels and Dielectric Tests –External Clearances in Air
IEC 60076-5	Part 5: Ability to withstand short circuit
IEC 60076-6	Part 6: Reactors
IEC 60076-7	Part 7: Loading guide for oil-immersed power transformers
IEC 60076-8	Part 8: Application guide
IEC 60076-10	Part 10: Determination of sound levels
IEC 60076-10-1	Part 10-1: Determination of sound levels - Application guide
IEC 60076-11	Part 11: Dry-type transformers
IEC 60076-12	Part 12: Loading guide for dry-type power transformers
IEC 60076-13	Part 13: Self-protected liquid-filled transformers
IEC 60076-14	Part 14: Design and application of liquid-immersed power transformers using high-temperature insulation materials
IEC 60076-15	Part 15: Gas-filled power transformers
IEC 60076-16	Part 16: Transformers for wind turbine applications
IEC 60076-18	Part 18: Measurement of frequency response
IEC 60076-19	Part 19: Rules for the determination of uncertainties in the measurement of losses in power transformers and reactors
IEC 60076-21	Part 21: Standard requirements, terminology, and test code for step-voltage regulators
IEC 60044, BS 3938	Current transformers
IEC 60050	International Electrotechnical Vocabulary
IEC 60050(421)	International Electrotechnical vocabulary- Chapter 421 : Power Transformers and Reactors
IEC 60060	High Voltage test techniques
IEC 60060-1	General definitions and test requirements
IEC 60060-2	Measuring systems
IEC 60071	Insulation co-ordination
IEC 60071-1	Part 1: Definitions, principles and rules
IEC 60071-2	Part 2 : Application guide
IEC 60137	Bushing for alternating voltage above 1000V
IEC 60214	On-Load Tap changers
IEC 255-21-3	Relays vibration

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

CODES	TITLE
IEC 60270	Partial discharge measurements
IEC 60296	Specification for Unused Mineral Oil for Transformers and Switchgear
IEC 60422	Supervision and Maintenance guide for Mineral Insulating Oil in Electrical Equipment
IEC 60475	Method of Sampling Liquid dielectrics
IEC 60529	Classification of Degrees of Protection provided by Enclosures
IEC 60542	Application Guide for On-Load Tap-Changers
IEC 60567	Guide for the Sampling of Gases and of Oil from Oil-filled Electrical Equipment for the Analysis of Free and Dissolved Gases
IEC 60651	Sound Level Meters
IEC 61083	Digital Recorders and Software for High Voltage Impulse testing
IEC 61083-1	Part 1: Requirements for digital recorders in high voltage impulse tests
IEC 61083-2	Part 2: Evaluation of software used for the determination of the parameters of impulse waveforms
CISPR 16	Specification for radio disturbance and immunity measuring apparatus
CISPR 16-1	Radio disturbance and immunity measuring apparatus
CISPR-18	Radio Interference Characteristics of Power Lines and High Voltage Equipment
ISO 9001	Quality system-Model for Quality Assurance in Design /development
Cigre Publication 202	Guidelines for conducting design reviews for transformers 100 MVA and 123 kV and above. August 2002-Cigre Working Group 12.22
WG 12-15	Guide for Customers Specifications for Transformers 100 MVA and 123 kV and above
WG 12 19	Short Circuit Performance of Transformers.
BS-4360	Specification for weldable structural steel
BS-5135	Specification for arc welding of carbon and carbon manganese steels
BS-5500	Specification for unfired fusion welded pressure vessels
IS-3618	Specification for phosphate treatment of iron & steel for protection against corrosion
IS-6005	Code of practice for phosphating of Iron and Steel
ISO-8501	Preparation of steel surface before application of Paints and related product
IEC-60599	Mineral oil impregnated electrical equipment in service – guide to the interpretation of dissolved and free gases analysis
IS-10593	Method of evaluating the analysis of gases in oil filled electrical equipment in service
IS-2099	Bushings for alternating voltages above 1000 volts

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

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

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

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

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

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

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

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

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

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

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

CODES	TITLE
ASTM-B 231-81	Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221	Aluminum - Alloy extruded bar, rod, wire, shape
ASTM-B 236-83	Aluminum bars for electrical purpose (Bus-bars)
ASTM-B 317-83	Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)
Batteries	
IS:1651	Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates)
IS:1652	Stationary Cells and Batteries, Lead-Acid Type (with Plante Positive Plates)
IS:1146	Rubber and Plastic Containers for Lead-Acid Storage Batteries
IS:6071	Synthetic Separators for Lead-Acid Batteries
IS:266	Specification for Sulphuric Acid
IS:1069	Specification for Water for Storage Batteries
IS:3116	Specification for Sealing Compound for Lead-Acid Batteries
IS:1248	Indicating Instruments
IS:10918	Vented type nickel Cadmium Batteries
IEC:60896-21&22	Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements
IEC: 60623	Vented type nickel Cadmium Batteries
IEC:60622	Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell
IEC:60623	Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell
IEC:60896-11	Stationary Lead Acid Batteries – Vented Type – General requirements & method of tests
IEEE-485	Recommended practices for sizing of Lead Acid Batteries
IEEE-1115	Sizing of Ni-Cd Batteries
IEEE-1187	Recommended practices for design & installation of VRLA Batteries
IEEE-1188	Recommended practices for design & installation of VRLA Batteries
IEEE-1189	Guide for selection of VRLA Batteries
Battery Charger	
IS:3895	Mono-crystalline Semiconductor Rectifier Cells and Stacks
IS:4540	Mono-crystalline Semiconductor Rectifier Assemblies and Equipment
IS:6619	Safety Code for Semiconductor Rectifier Equipment
IS:2026	Power Transformers
IS:2959	AC Contactors for Voltages not Exceeding 1000 Volts

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

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

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

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

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

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

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CODES	TITLE
BS:599	Methods of testing pumps
PTC-8.2	Power Test Codes - Centrifugal pumps
DIESEL ENGINES	
IS:10000	Methods of tests for internal combustion engines
IS:10002	Specification for performance requirements for constant speed compression ignition engines for general purposes (above 20 kW)
BS:5514	The performance of reciprocating compression ignition (Diesel) engines, utilizing liquid fuel only, for general purposes
ISO:3046	Reciprocating internal combustion engines performance
IS:554	Dimensions for pipe threads where pressure tight joints are required on threads
ASME Power Test Code	Internal combustion engine PTC-17
--	Codes of Diesel Engine Manufacturer's Association, USA
PIPING VALVES & SPECIALITIES	
IS:636	Non percolating flexible fire-fighting delivery hose
IS:638	Sheet rubber jointing and rubber inserting jointing
IS:778	Gun metal gate, globe and check valves for general purpose
IS:780	Sluice valves for water works purposes (50 to 300 mm)
IS:901	Couplings, double male and double female instantaneous pattern for fire fighting
IS:902	Suction hose couplings for fire-fighting purposes
IS:903	Fire hose delivery couplings branch pipe nozzles and nozzle spanner
IS:1538	Cast iron fittings for pressure pipes for water, gas and sewage
IS:1903	Ball valve (horizontal plunger type) including floats for water supply purposes
IS:2062	SP for weldable structural steel
IS:2379	Colour Code for the identification of pipelines
IS:2643	Dimensions of pipe threads for fastening purposes
IS:2685	Code of Practice for selection, installation and maintenance of sluice valves
IS:2906	Sluice valves for water-works purposes (350 to 1200 mm size)
IS:3582	Basket strainers for fire-fighting purposes (cylindrical type)
IS:3589	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
IS:4038	Foot valves for water works purposes
IS:4927	Unlined flax canvas hose for fire fighting
IS:5290	Landing valves (internal hydrant)
IS:5312 (Part-I)	Swing check type reflex (non-return) valves
IS:5306	Code of practice for fire extinguishing installations and equipment on premises

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CODES	TITLE
Part-I	Hydrant systems, hose reels and foam inlets
Part-II	Sprinkler systems
BS:5150	Specification for cast iron gate valves
MOTORS & ANNUNCIATION PANELS	
IS:325	Three phase induction motors
IS:900	Code of practice for installation and maintenance of induction motors
IS:996	Single phase small AC and universal electric motors
IS:1231	Dimensions of three phase foot mounted induction motors
IS:2148	Flame proof enclosure of electrical apparatus
IS:2223	Dimensions of flange mounted AC induction motors
IS:2253	Designations for types of construction and mounting arrangements of rotating electrical machines
IS:2254	Dimensions of vertical shaft motors for pumps
IS:3202	Code of practice for climate proofing of electrical equipment
IS:4029	Guide for testing three phase induction motors
IS:4691	Degree of protection provided by enclosure for rotating electrical machinery
IS:4722	Rotating electrical machines
IS:4729	Measurement and evaluation of vibration of rotating electrical machines
IS:5572	Classification of hazardous areas for electrical (Part-I) installations (Areas having gases and vapours)
IS:6362	Designation of methods of cooling for rotating electrical machines
IS:6381	Construction and testing of electrical apparatus with type of protection 'e'
IS:7816	Guide for testing insulation for rotating machine
IS:4064	Air break switches
IEC DOCUMENT 2 (Control Office) 432	Three Phase Induction Motor
VDE 0530 Part I/66	Three Phase Induction Motor
IS:9224 (Part-II)	HRC Fuses
IS:6875	Push Button and Control Switches
IS:694	PVC Insulated cables
IS:1248	Indicating instruments
IS:375	Auxiliary wiring & busbar markings
IS:2147	Degree of protection
IS:5	Colour Relay and timers
IS:2959	Contactors
PG Test Procedures	

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

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

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

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

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

CODES	TITLE
ASTM-A120	Specification for pipe steel, black and hot dipped, zinc-coated (Galvanized) welded and seamless steel pipe for ordinary use
ASTM-A53	Specification for pipe, steel, black, and hot-dipped, zinc coated welded and seamless
ASTM-A106	Seamless carbon steel pipe for high temperature service
ASTM-A284	Low and intermediate tensile strength carbon-silicon steel plates for machine parts and general construction
ASTM-A234	Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM-S181	Specification for forgings, carbon steel for general purpose piping
ASTM-A105	Forgings, carbon steel for piping components
ASTM-A307	Carbon steel externally threaded standard fasteners
ASTM-A193	Alloy steel and stainless steel bolting materials for high temperature service
ASTM-A345	Flat rolled electrical steel for magnetic applications
ASTM-A197	Cupola malleable iron
ANSI-B2.1	Pipe threads (Except dry seal)
ANSI-B16.1	Cast iron pipe flanges and flanged fitting. Class 25, 125, 250 and 800
ANSI-B16.1	Malleable iron threaded fittings, class 150 and 300
ANSI-B16.5	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B16.9	Factory-made wrought steel butt welding fittings
ANSI-B16.11	Forged steel fittings, socket-welding and threaded
ANSI-B16.14	Ferrous pipe plug, bushings and locknuts with pipe threads
ANSI-B16.25	Butt welding ends
ANSI-B18.1.1	Fire hose couplings screw thread
ANSI-B18.2.1	Inch series square and hexagonal bolts and screws
ANSI-B18.2.2	Square and hexagonal nuts
ANSI-B18.21.1	Lock washers
ANSI-B18.21.2	Plain washers
ANSI-B31.1	Power piping
ANSI-B36.10	Welded and seamless wrought steel pipe
ANSI-B36.9	Stainless steel pipe
Other civil works standards	
IS-269	33 grade ordinary portland cement
IS-2721	Galvanized steel chain link fence fabric
IS-278	Galvanized steel barbed wire for fencing
IS-383	Coarse and fine aggregates from natural sources for concrete
IS-432 (P1 and P2)	Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement

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

CODES	TITLE
IS-456	Code of practice for plain and reinforced concrete
IS-516	Method of test for strength of concrete
IS-800	Code of practice for general construction in steel
IS-806	Steel tubes for structural purposes
IS-1172	Basic requirements for water supply, drainage and sanitation
IS-1199	Methods of sampling and analysis of concrete
IS-1566	Hard-drawn steel wire fabric for concrete reinforcement
IS-1742	Code of Practice for Building drainage
IS-1785	Plain hard-drawn steel wire for pre-stressed concrete
IS-1786	High strength deformed Steel Bars and wires for concrete reinforcement
IS-1811	Methods of sampling Foundry sands
IS-1893	Criteria for earthquake resistant design of structures
IS-2062	Steel for general structural purposes
IS-2064	Selection, installation and maintenance of sanitary appliances-code of practices
IS-2065	Code of practice for water supply in buildings
IS-2090	High tension steel bars used in pre-stressed concrete
IS-2140	Standard Galvanized steel wire for fencing
IS-2470 (P1 & P2)	Code of practice for installation of septic tanks
IS-2514	Concrete vibrating tables
IS-2645	Integral cement waterproofing compounds
IS-3025 (Part 1 to Part 48)	Methods of sampling and test (Physical and chemical) for water and waste water
IS-4091	Code of practice for design and construction of foundations for transmission line towers and poles
IS-4111 (Part 1 to P5)	Code of practice for ancillary structures in sewerage system
IS-4990	Plywood for concrete shuttering work
IS-5600	Sewage and drainage pumps
National building code of India 1970	
USBR E12	Earth Manual by United States Department of the interior Bureau of Reclamation
ASTM-A392-81	Zinc/Coated steel chain link fence fabric
ASTM-D1557-80	test for moisture-density relation of soils using 10-lb (4.5 kg) rammer 18-in. (457 mm) Drop
ASTM-D1586(1967)	Penetration Test and Split-Barrel Sampling of Soils
ASTM-D2049-69	Test Method for Relative Density of Cohesionless Soils
ASTM-D2435	Test method for Unconsolidated, (1982) Undrained Strengths of Cohesive Soils in Triaxial Compression
BS-5075	Specification for accelerating Part I Admixtures, Retarding Admixtures and Water Reducing Admixtures

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

CODES	TITLE
CPWD	Latest CPWD specifications
ACSR MOOSE CONDUCTOR	
IS:6745 BS:443-1969	Methods for Determination of Mass of zinc coating on zinc coated Iron and Steel Articles
IS:8263	Methods for Radio Interference
IEC:437-1973 NEMA:107-1964 CISPR	Test on High Voltage Insulators
IS:209, BS:3436-1961	Zinc Ingot
IS:398 Part - V IEC:209-1966	Aluminum Conductors for Overhead Transmission Purposes
BS:215(Part-II), IEC:209-1966	Aluminium Conductors galvanized steel reinforced extra high voltage (400 kV and above)
IS:1778, BS:1559-1949	Reels and Drums for Bare Conductors
IS:1521, ISO/R89-1959	Method for Tensile Testing of steel wire
IS:2629	Recommended practice for Hot dip Galvanising on Iron and Steel
IS:2633	Method for Testing Uniformity of coating of zinc Coated Articles
IS:4826/ ASTMA-472-729	Hot dip galvanised coatings on round steel wires
GALVANISED STEEL EARTHWIRE	
IS:1521, ISO/R:89-1959	Method for Tensile Testing of Steel Wire
IS:1778	Reels and Drums for Bare Conductors
IS:2629	Recommended practice for Hot Dip Galvanising on Iron and Steel
IS:2633	Methods for testing Uniformity of Coating of Zinc Coated Articles
IS:4826/ ASTM: A 475-72a BS:443-1969	Hot dip Galvanised Coatings on Round Steel Wires
IS:6745/ BS:443-1969	Method for Determination of mass of Zinc Coating on Zinc coated Iron and Steel Articles.
IS:209/ BS:3463-1961	Zinc ingot
IS:398 (Pt. I to P5:1992)/ BS:215 (Part-II)	Aluminum Conductors for overhead transmission purposes
Lighting Fixtures and Accessories	
IS:1913	General and safety requirements for electric lighting fittings
IS:3528	Water proof electric lighting fittings
IS:4012	Dust proof electric lighting fittings
IS:4013	Dust tight proof electric lighting fittings
IS:10322	Industrial lighting fittings with metal reflectors
IS:10322	Industrial lighting fittings with plastic reflectors
IS:2206	Well glass lighting fittings for use under ground in mines (non-

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

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

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

CODES	TITLE
IS:3854	Switches for domestic and similar purposes
IS:5216	Guide for safety procedures and practices in electrical work
IS:732	Code of practice for electrical wiring installation (system voltage not exceeding 650 Volts.)
IS:3043	Code of practice for earthing
IS:3646	Code of practice of interior illumination part II & III
IS:1944	Code of practice for lighting of public through fares
IS:5571	Guide for selection of electrical equipment for hazardous areas
IS:800	Code of practice for use of structural steel in general building construction
IS:2633	Methods of Testing uniformity of coating on zinc coated articles
IS:6005	Code of practice for phosphating iron and steel
	INDIAN ELECTRICITY ACT
	INDIAN ELECTRICITY RULES
LT SWITCHGEAR	
IS:8623 (Part-I)	Specification for low voltage switchgear and control gear assemblies
IS:13947 (Part-I)	Specification for low voltage switchgear and control gear, Part 1 General Rules
IS:13947 (part-2)	Specification for low voltage switchgear and control gear, Part 2 circuit breakers
IS:13947 (part-3)	Specification for low voltage switchgear and control gear. Part 3 Switches, Disconnectors, Switch-disconnectors and fuse combination units
IS:13947 (part-4)	Specification for low voltage switchgear and control gear. Part 4 Contactors and motors starters
IS:13947 (part-5)	Specification for low voltage switchgear and control gear. Part 5 Control-circuit devices and switching elements
IS:13947 (part-6)	Specification for low voltage switchgear and control gear. Part 6 Multiple function switching devices
IS:13947 (part-7)	Specification for low voltage switchgear and control gear. Part 7 Ancillary equipments
IS:12063	Degree of protection provided by enclosures
IS:2705	Current Transformers
IS:3156	Voltage Transformers
IS:3231	Electrical relays for power system protection
IS:1248	Electrical indicating instruments
IS:722	AC Electricity meters
IS:5578	Guide for Marking of insulated conductors of apparatus terminals
IS:13703 (part 1)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 1 General Requirements
IS:13703 (part 2)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 2 Fuses for use of authorized persons

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

CODES	TITLE
IS:6005	Code of practice of phosphating iron and steel
IS:5082	Wrought Aluminum and Aluminum alloys for electrical purposes
IS:2633	Hot dip galvanising

COMPREHENSIVE LIST OF DRAWINGS		
SL. NO.	DRAWINGS/DOCUMENTS TITLE	CATEGORY
1.00	SUBSTATION LAYOUT DRAWINGS	
1.01	Single Line Diagram of substation	A
1.02	Electrical layout (plan & section) drawing	A
1.03	Overall General Arrangement drawing	A
1.04	Structure loading diagram cum layout drawing	A
1.05	DSLPP Layout drawing	A
1.06	Switchyard Foundation layout drawing	A
1.07	Erection Key Diagram (plan & section) & Erection Bill of quantity	A
1.08	Indoor Cable trench layout drawing	A
1.09	Outdoor Cable trench layout drawing	A
1.10	Buried cable trench layout drawing	A
1.11	Lighting Fixture & conduit layout – Control room building	A/R
1.12	Lighting Fixture & conduit layout – FFPH building	A/R
1.13	Lighting Fixture & conduit layout – Transit camp (if applicable)	A/R
1.14	Lighting Fixture & conduit layout – Switchyard/Street	A/R
1.15	Lighting Fixture & conduit layout – Switchyard panel room	A/R
1.15	Earthing layout - Control Room building	A
1.16	Earthmat layout – Outdoor Switchyard area	A
1.17	Layout drawing for gravel and fence	A
1.18	Switchyard Road & drain layout drawing	A
1.19	Layout drawing of Visual Monitoring System	A
1.20	SLD of LT AC/DC systems	A
1.21	LT switchgear room -Panel layout	A
1.22	Fire Fighting Piping layout in the switchyard	A
1.23	Fire protection system (Hydrant system & Extinguishers) for Control room building, GIS Building & FFPH building etc	A
1.24	HVW spray system drawings (plan, elevation, side view, isometric view and pylon support location details)	A
1.25	NIFPS drawings	A
1.26	Fire detection & Alarm system for Control room building, GIS Building & Switchyard panel room	A
1.27	Panel layout in Control room building	A
1.28	Layout drawing for LT station	A
1.29	Switchyard Panel room - Panel layout	A
1.30	Power cable termination schedule	R
1.31	Control cable termination schedule	R
	Applicable for GIS	
1.32	Gas System Line Diagram (GAS SLD) indicating compartment details & Weight	A
1.33	GIS Layout drawing including outdoor GIB (Plan & Section)	A
1.34	Layout drawing of UHF sensors for PD Measurement	A
1.35	GIS building - Layout drawing	A
1.36	GIS Building – Lighting Fixture & conduit layout	A
1.37	GIS Building - Layout drawing of Ventilation System	A

COMPREHENSIVE LIST OF DRAWINGS		
1.38	GIS Building (Panel Room) – Air Conditioning system layout drawing	A
1.39	GIS Building – Indoor cable trench Layout drawing	A
2.00	DESIGN CALCULATION	
2.01	DSLIP Calculation	A
2.02	Sag Tension & Short Circuit Force Calculation (if applicable)	R
2.03	Lighting system design calculation (if applicable)	R
2.04	Earthing system design calculation (if applicable)	R
2.05	Battery/Charger sizing calculation (if applicable)	R
2.06	Hydraulic calculations for Fire protection system	R
2.07	AC & Ventilation calculation for GIS Building (if applicable)	R
2.08	EOT crane sizing for GIS building	R
3.00	GAS INSULATED SWITCHGEAR	
3.01	Design Review document along with all supporting documents	A
3.02	Guaranteed Technical Particular (GTP)	A
3.03	Components GA drawing for CB, DS, ES, GIB, CT, VT, Spacers, Bushings etc.	A
3.04	Schematics for CB, DS,ES, CT, VT etc. (Except for LCC)	A
3.05	Type Test Reports for GIS Equipments	A
3.06	Detailed drawing of Bus Extension Module	
3.07	Foundation plan for GIS (Including Loading Data)	A
3.08	Platform Arrangement	R
3.09	Name Plates	R
3.10	GA & Schematic drawings of Local Control Cabinets (LCC)	A
3.11	GA & Schematic drawings of overhead crane	A
3.12	Earthing layout inside GIS building	R
3.13	Catalogues for	R
a)	SF6 gas leakage detector	
b)	SF6 gas filling & evacuation plant	
c)	SF6 gas Analyser	
d)	On line partial discharge monitoring system	
3.14	List of Mandatory spares	A
3.15	List of Special Tools & Tackles	A
3.16	Instruction Manual including catalogue of sensors	R
4.00	AUTOTRANSFORMER	
4.01	Design Review	A
4.02	Guaranteed Technical Particulars	A
4.03	Outline General Arrangement Drawing with Bill of material (OGA parts list)	A
4.04	Foundation Plan	A
4.05	Over Fluxing withstand duration curve	R
4.06	Hysteresis Characteristics & specific loss vs flux density curve of iron core	R
4.07	General Arrangement & Control Schematic of OLTC along with write-up	A
4.08	General Arrangement & Control Schematic of Marshalling Box, Common Marshalling Box and Cooler control cubicle along with write-up	A

COMPREHENSIVE LIST OF DRAWINGS		
4.09	General Arrangement & Control Schematic of Digital RTCC relay and cubicle	A
4.10	Interconnection diagram of Drive Mechanism Box, Marshalling Box, Common Marshalling Box & Digital RTCC.	A
4.11	SCADA communication interface of online monitoring equipment	A
4.12	Transport Drawing	R
4.13	Technical Particulars of Online DGA, Drying system, FO system	A
4.14	Outline and control schematic of NIFPS	A
4.15	GA & GTP of bushings	A
4.16	Earthing Arrangement Drawing (Internal & External)	A
4.17	Drawing of Aircell, Conservator & Radiator	A
4.18	Conservator & Tank Oil filling procedure plate	R
4.19	Magnetizing Characteristics of bushings CT	R
4.20	Rating and Diagram plate	A
4.21	Oil flow Diagram	R
4.22	Valve Schedule plate drawing	A
4.23	GA of Twin-Bi directional roller	A
4.24	Instruction Manual	R
4.25	Type Test Report	A
5.00	REACTOR	
5.01	Design Review	A
5.02	Guaranteed Technical Particulars	A
5.03	Outline General Arrangement Drawing with Bill of material (OGA parts list)	A
5.04	Foundation Plan	A
5.05	General Arrangement & Control Schematic of Marshalling Box, Common Marshalling Box along with write-up	A
5.06	SCADA communication interface of online monitoring equipment	A
5.07	Transport Drawing	R
5.08	Technical Particulars of Online DGA, Drying system, FO system	A
5.09	Outline and control schematic of NIFPS	A
5.10	GA & GTP of bushings	A
5.11	Earthing Arrangement Drawing (Internal & External)	A
5.12	Drawing of Aircell, Conservator & Radiator	R
5.13	Conservator & Tank Oil filling procedure plate	R
5.14	Magnetization characteristics of Reactor Core and bushing CTs	R
5.15	Hysteresis Characteristics & specific loss vs flux density curve of iron core	R
5.16	Rating and diagram plate	A
5.17	Voltage Ampere curve for Reactor	R
5.18	Valve Schedule plate drawing	A
5.19	GA of Twin bi-directional roller	A
5.20	Instruction Manual	R
5.21	Type test Report	A
6.00	NEUTRAL GROUNDING REACTOR (NGR)	
a)	AIR CORE TYPE NGR	

COMPREHENSIVE LIST OF DRAWINGS		
6.01	Design Review Document	A
6.02	General Technical Particulars	A
6.03	General Arrangement Drawing with BOM	A
6.04	Main Coil Lifting Details	R
6.05	Foundation Detail Drawing	R
6.06	Main Coil & Insulator Assembly Drawing	A
6.07	Terminal Detail Drawing	A
6.08	Rating & Diagram Plate	A
6.09	Transport Drawing	R
6.10	NGR Pedestal Drawing	A
b)	OIL FILLED TYPE NGR	
6.11	Design Review Document	A
6.12	General Technical Particulars	A
6.13	General Arrangement Drawing with BOM	A
6.14	Foundation Detail Drawing	R
6.15	Combined Foundation of Reactor, NGR and LA	A
6.16	Rating & Diagram Plate	A
6.17	Transport Drawing	R
6.18	Control Schematic	A
7.00	CIRCUIT BREAKER	
7.01	GA drawing of SF6 CB	A
7.02	GTP	A
7.03	OGA drawing of control unit	A
7.04	OGA drawing of support insulator, interrupter insulator, PIR chamber insulator, grading capacitor insulator (as applicable)	R
7.05	Support structure & foundation plan drawing	A
7.06	Schematic drawings/Wiring diagrams	A
7.07	Rating and name plate drawing	A
7.08	SF6 gas connection diagram	R
7.09	Schematic diagram of operating mechanism	R
7.10	GA drawing, GTP & Type Test Reports of Controlled Switching Device	A
7.11	Terminal pad and corona rings	R
7.12	Sectional view of interrupter	R
7.13	Type Test Reports	A
7.14	Instruction Manual	R
8.00	ISOLATOR	
8.01	GA drawing of Isolator with/without earth switch	A
8.02	GTP	A
8.03	Contact blade assembly (main & earth switch)	R
8.04	Terminal pad & hinge contacts	R
8.05	GA of MOM – main switch	R
8.06	Schematic & wiring drawing for main switch	R
8.07	Name plate - details	A
8.08	GA of terminal pad	A

COMPREHENSIVE LIST OF DRAWINGS		
8.09	GA of post insulator for isolator	R
8.10	Type Test Report	A
8.11	Instruction Manual	R
9.00	INSTRUMENT TRANSFORMER (CT/CVT/IVT)	
9.01	General Arrangement	A
9.02	GTP	A
9.03	Sectional view	R
9.04	Sec. terminal box GA	R
9.05	Wiring drawing of JB incl. interpole	R
9.06	Terminal pads	A
9.07	Schematic & rating plate	R
9.08	Porcelain insulator	R
9.09	Corona ring	R
9.10	Type Test Reports	A
9.11	Instruction Manual	R
10.00	SURGE ARRESTER	
10.01	GA of Surge Arrester	A
10.02	GTP	A
10.03	Porcelain/ Polymer insulator	R
10.04	Cross sectional view	R
10.05	Arrestor and unit name plate	A
10.06	Corona & Grading rings	R
10.07	Insulating base / surge counter detail	R
10.08	Outline drawing of surge counter	R
10.09	Circuit diagram of surge counter	R
10.10	GA drawing of ZnO element	R
10.11	Line terminal bracket with corona rings	R
10.12	Drawing showing pressure relief arrangement.	R
10.13	Type Test Report	A
10.14	Instruction Manual	R
11.00	BUS POST INSULATOR	
11.01	GA drawing & GTP	A
11.02	Type Test Reports	A
12.00	Marshalling Box, Junction Boxes	
12.01	GA drawings	A
12.02	Schematic drawings	A
12.03	Type Test Reports	A
13.00	CONDUCTOR, AL. TUBE & GS EARTH WIRE	
13.01	Type Test Reports (if applicable)	A

COMPREHENSIVE LIST OF DRAWINGS		
14.00	DISC INSULATOR	
14.01	GA drawing & GTP	A
14.02	Type Test Reports	A
15.00	LONG ROD POLYMER INSULATOR	
15.01	GA drawing & GTP	A
15.02	Type Test Reports	A
16.00	INSULATOR STRING(S) WITH HARDWARE ASSEMBLY	
16.01	GA drawing & GTP	A
16.02	Component drawings	R
16.03	Type Test Reports	A
17.00	CLAMPS & CONNECTORS	
17.01	GA Drawings	A
17.02	Type Test Reports	A
18.00	HORN GAP FUSE	
18.01	GA drawing & GTP	A
18.02	Type Test Reports	A
19.00	BATTERY AND BATTERY CHARGER	
19.01	GA drawing & GTP of Battery Bank	A
19.02	GA drawing, GTP & Schematic Drawings of Battery Charger	A
19.03	Type Test Reports of Battery & Charger	A
20.00	ILLUMINATION	
20.01	GTP/Catalogue of fittings/fixtures	A
20.02	GA drawing of lighting poles/posts	A
20.03	GA drawing of Junction box	A
20.04	GA drawing of street lighting panel/outdoor/indoor lighting panel	A
20.05	GA drawing of Receptacles	A
20.06	Schematic drawing of panel/LDBs to fixtures	R
21.00	LT SWITCHGEAR	
21.01	SLD, GA & Schematic drawings of MSB	A
21.02	SLD, GA & Schematic drawings of ACDB	A
21.03	SLD, GA & Schematic drawings of 220V DCDB	A
21.04	SLD, GA & Schematic drawings of 48V DCDB	A
21.05	SLD, GA & Schematic drawings of MLDB	A
21.06	SLD, GA & Schematic drawings of ELDB	A
21.07	Type Test Reports	A
21.08	Instruction Manual	R

COMPREHENSIVE LIST OF DRAWINGS		
22.00	HT POWER CABLES	
22.01	GTP & Catalogue	A
22.02	Type Test Reports	A
23.00	POWER & CONTROL CABLES	
23.01	Type Test Reports for control cables	A
23.02	Type Test Reports for power cables	A
24.00	CONTROL AND RELAY PANELS & SUBSTATION AUTOMATION SYSTEM (SAS), VISUAL MONITORING SYSTEM (VMS)	
24.01	GTP for all protection relays, Travelling Wave Fault Locator, SAS Equipment	A
24.02	Type Test Reports of all protection relays , Travelling Wave Fault Locator & SAS IEDs	A/R
24.03	GA and schematic drgs. for :-	
a)	Relay and protection panels for all type of line(s)	A
b)	Relay and protection panels for all type transformer(s) including tertiary loading	A
c)	Relay and protection panels for bus/line reactor(s) (switchable & non-switchable as applicable)	A
d)	Relay and protection panels for tie bay(s)	A
e)	Relay and protection panels for TBC bay(s)	A
f)	Relay and protection panels for BC bay(s)	A
g)	Relay and protection panels for Bus Sectionalizer bay(s)	A
h)	Busbar protection panel (s)	A
i)	Breaker relay panel(s)	A
j)	Interface panel	A
24.04	SAS Architecture	A
24.05	Relay Settings	A
24.06	GTP/Catalogue of VMS equipment	A/R
24.07	GTP/Catalogue of Camera	A/R
24.08	VMS architecture drawing	A
24.09	Technical Literature and O&M manuals	R
25.00	PLCC EQUIPMENTS	
25.01	GTP/Drawings for PLCC Carrier Equipment	A/R
25.02	GTP/Drawings for Wave traps	A
25.03	GTP/Drawings Coupling device	A
25.04	Digital/ Analog Protection coupler	A
25.05	SNR calculation (if applicable)	R
25.06	GTP/Drawing of HF cable	A
25.07	Type Test Reports of PLCC equipment	A
25.08	Testing & maintenance equipments	R
25.09	Frequency Planning	A
25.10	Technical literature and O&M Manuals	R

COMPREHENSIVE LIST OF DRAWINGS		
26.00	DG SET	
26.01	GTP	A
26.02	Drawings/manuals	A
27.00	AIR CONDITIONING & VENTILATION SYSTEM	
27.01	Drawings/GTP/Catalogues	A
27.02	A/C sizing calculation	A
28.00	LT TRANSFORMER	
28.01	GTP	A
28.02	Drawings	A
28.03	Type Test Reports	A
29.00	FIRE PROTECTION SYSTEM	
29.01	Fire Fighting Annunciation & control panels	A
29.02	GA and Schematic for LCP for deluge valve operation	A
29.03	Hydraulic calculations for HVW spray network	R
29.04	Drawing for deluge valve housing	A
29.05	GTP & drawings for strainers (Y type & basket strainer)	A
29.06	Drawing of valve pit details	A
29.07	System write-up with various settings	A
29.08	GTP & drawing for gate valve, check valve, solenoid valve, outdoor hydrant valve	A
29.09	GTP & catalogue for deluge valve, spray nozzles & projectors	A
29.10	GTP & catalogue for quatrzoid bulb detector	A
29.11	GTP & drawing for pressure switch, pressure gauge	A
29.12	GTP for G.I. & M.S. pipes & pipe accessories	A
29.13	Any other drawing/document required for completion of work	A/R
30.00	CONTROL ROOM BUILDING / TRANSIT CAMP /FFPH BUILDING/ SWITCHAYRD PANEL ROOM/INDOOR HT SWITCHGEAR ROOM/TOWNSHIP BUILDINGS (AS applicable)	A
30.01	Architectural drawing	
a)	Plan, section & elevation	
b)	Doors & windows schedule	
30.02	Building design calculation (if applicable)	
30.03	Civil Construction design/drawings	
31.00	DRAWING FOR GIS BUILDING (If applicable)	A
31.01	Architectural drawing	
a)	Plan, section & elevation	
b)	Doors & windows schedule	
31.02	GIS building superstructure drawings & design calculation	
31.03	Civil Construction design/drawings	

COMPREHENSIVE LIST OF DRAWINGS		
31.04	GIS Equipment foundation inside GIS building	
32.00	Switchyard Civil Construction Drawings (as applicable)	A
a)	Tower Foundation	
b)	Equipment Foundation	
c)	Transformer foundation	
d)	Reactor foundation	
e)	Road construction including culverts, rail cum road	
f)	Switchyard fencing & Gate	
g)	Cable trench section	
h)	Drain section	
i)	Rain harvesting	
j)	Boundary wall	
k)	DG set foundation	
l)	LT transformer foundation	
m)	Car Parking Shed/Security Room	
n)	Outdoor GIB foundation	
o)	Outdoor Sf6/Air bushing foundation	
p)	BMK/ Lighting pole foundation	
q)	Fire Wall	
r)	Drawing of contour levels	
s)	Drawing of Formation levels	
t)	Soil Investigation Report	
u)	Any other foundation inside switchyard	
33.00	DESIGN, FABRICATION & PROTO CORRECTED DRAWINGS OF ALL TYPES OF TOWERS & BEAMS	A/R
34.00	DESIGN, FABRICATION DRAWINGS FOR EQUIPMENT SUPPORT STRUCTURES	A/R
35.00	MISCELLANEOUS CIVIL DRGS	A/R

LEGEND:- A – for Approval; R- for Record

NOTES:-

- 1. In case any additional drawings/documents are required, the same shall also be submitted during execution of the contract.**
- 2. In case, some drawings as mentioned in the above list are not applicable for the scope of work, the same shall not be referred to.**

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

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

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

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

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

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

Note:

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

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ANNEX C1

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1. General

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

2. Test Levels:

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

3. Test Methods for RIV:

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

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

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

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

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

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

4. Test Methods for Visible Corona [applicable for 400kV and above]

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 110% of RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4

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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.

In case corona inception does not take place at 110%, voltage shall not be increased further and corona extinction voltage shall be considered adequate.

- 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 100 microvolts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE-A

COMPLIANCE CERTIFICATE OF TECHNICAL SPECIFICATION

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.
2. There are no deviation(s) with respect to specification other than those furnished in the schedule of technical deviations
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in BOQ of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

Date:

Bidder's Stamp & Signature

ANNEXURE - B

SCHEDULE OF TECHNICAL DEVIATIONS

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

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