

# **PROJECT IMPLEMENTATION UNIT GANDHINAGAR**



## **TECHNICAL SPECIFICATIONS FOR ELECTRICAL**

**Name of Work: - New Construction of 30 Bedded Community Health Center  
at.Thangadh, Ta.Thangadh, Dist.Surendranagar.**

**Project Implementation Unit  
4<sup>th</sup> Floor, PIU/RDD/NHM Building,  
Civil Hospital Compound, Sector-12,  
Gandhinagar –382 012.**

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

### INDEX

Sr. No.	Description – Technical Specification	Page No.
1	LT XLPE CABLE	02
2	INTERNAL WIRING	07
3	LIGHTING DISTRIBUTION BOARDS	20
4	LIGHT FIXTURE	24
5	EARTHING SYSTEM	30
6	LIGHTENING PROTECTION	36
7	ERECTION, TESTING & COMMISSIONING OF ELECTRICAL INSTALLATIONS	45
8	UPS	62
9	TECHNICAL SPECIFICATIONS FOR ELECTRICAL SOLAR POWER GENERATION	75
10	FLOOR RACEWAYS & UPVC TRUNKING	78
11	MEDIUM VOLTAGE PANEL	82
12	DG SET	105
13	DG SET INSTALLATION	123
14	ELECTRICAL ITEMS (TRANSFORMER & D.G. SET) OPERATION AND MAINTENANCE	127
15	TTA LT PANEL	140
16	HT PANEL	160
17	HT CABLE	170
18	OIL TYPE TRANSFORMER	173
19	LT BUSDUCTS	190
20	Energy and Power Management Software Specification (EMS)	191

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

1.0 TECHNICAL SPECIFICATIONS FOR LT XLPE CABLE					
1.0	<b><u>SCOPE OF WORK</u></b>				
	This section shall cover supply, laying, testing and commissioning of medium voltage XLPE cables.				
	This specification gives the general requirement of cables. However, it is the responsibility of the vendor to take the joint measurement and obtain client's approval before the placement of orders to the main supplier / manufacturer.				
2.0	<b><u>CODES &amp; STANDARDS</u></b>				
	The following standards and rules shall be applicable :				
	Sr. No	Item	Relevant IS	Relevant IEC	
	1	XLPE insulated electric cables (heavy duty).	IS : 7098 Part I		
	2	Recommended current ratings for cables.	IS : 3961		
	3	Aluminium conductors for insulated cables	IS : 8130	Indian Electricity Act and Rules.	
3.0	<b><u>DESIGN BASIS &amp; SITE CONDITIONS</u></b>				
	All equipment and materials will be selected and rated for use at the following site conditions.				
	<b>Site conditions</b>				
	<b>Location</b> Rajpipla Medical Campus		RAJPIPLA		
	<b>Ambient temperature</b>		<b>Relative humidity</b>		
	<b>Maximum</b>	47 0 C	<b>Maximum</b>	98 %	
	<b>Minimum</b>	5 0 C	<b>Minimum</b>	40 %	
	<b>Design</b>	45 0 C	<b>Design</b>	98 % at 45 0 C	
	<b>Seismic factor</b>	As per IS:1893			
	<b>Environmental</b>	Non corrosive, Humid and Dusty		<b>Location of Equipment</b> Ground/Air	
	<b>Wind speed</b>	80 kmph maximum			

# TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<b>Electrical system data :</b>			
	<b>Power supply for Equipment</b>			
	<b>Voltage</b> 415 V ± 5 %		<b>Frequency</b> 50 Hz ± 3 %	
	<b>Permissible combined voltage &amp; frequency variation</b>	± 6 %	<b>System design faults level (Symmetrical)</b> 35 kA – 60 kA as per specified in SLD for 1-3 sec. max.	
	<b>System earthing</b> LV side neutral solidly earthed		<b>Wiring</b> 3 phase, 4 wire on 415V system	
	<b>Auxiliary power supply</b>			
	<b>Power supply</b>	240V AC, 1-Ph, 50Hz		
	<b>Control Supply</b>	-----		
	<b>Space heater power supply</b>		240V AC, 1-Ph, 50Hz	
	<b>Illumination power supply</b>		240V AC, 1-Ph, 50Hz	
	<b>Plug-socket power supply</b>		240V AC, 1-Ph, 50Hz	
<b>4.0</b>	<b><u>TECHNICAL REQUIREMENTS</u></b>			
	<b><u>GENERAL CONSTRUCTIONAL FEATURES</u></b>			
	The medium voltage cables shall be supplied, laid, connected, tested and commissioned in accordance with the drawings, specifications, relevant Indian Standards specifications, manufacturer’s instructions. The cables shall be delivered at site in original drums with manufacturer’s name, size, and type, clearly written on the drums.			
	<b><u>MATERIAL</u></b>  Medium voltage cable shall be XLPE insulated. PVC sheathed, aluminium or copper conductor, armoured conforming to IS: 7098 Part I.			
	<b><u>Type:</u></b>  The cables shall be circular, multi core, annealed copper or aluminium conductor, XLPE insulated and PVC sheathed, armoured or unarmoured.			
	<b><u>Conductor:</u></b>  Uncoated, annealed copper / aluminium, of high conductivity upto 4 mm. <sup>2</sup> size, the conductor shall			

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	be solid and above 4 mm. <sup>2</sup> , conductors shall be concentrically stranded as per IEC: 228.
	<p><b><u>Insulation:</u></b></p> <p>XLPE rated 70° c. extruded insulation</p>
	<p><b><u>Core Identification:</u></b></p> <p>Two core : Red and Black</p> <p>Three core : Red, Yellow and Blue</p> <p>Four core : Red, Yellow, Blue and Black</p> <p>Single core : Green, Yellow for earthing</p> <p>Black shall always be used for neutral.</p>
	<p><b><u>Assembly:</u></b></p> <p>Two, three or four insulated conductors shall be laid up, filled with non-hygroscopic material and covered with an additional layer of thermoplastic material.</p>
	<p><b><u>Armour:</u></b></p> <p>Galvanised steel flat strip / round wires applied helically in single layers complete with covering the assembly of cores.</p> <p>For cable size upto 25 Sq. mm. : Armour of 1.4 mm dia G.I. round wire</p> <p>For cable size above 25 Sq. mm. : Armour of 4 mm wide 0.8 mm thick G.I strip</p>
	<p><b><u>Sheath:</u></b></p> <p>XLPE 70 deg.c. rated extruded.</p> <p>Inner sheath shall be extruded type and shall be compatible with the insulation provided for the cables.</p> <p>Outer sheath shall be of an extruded type layer of suitable PVC material compatible with the specified ambient temp. 50 deg. C and operating temperature of cables. The sheath shall be resistant to water, ultraviolet radiation, fungus, termite and rodent attacks. The colour of outer sheath shall be black. Sequential length marking required at every 1.0 mtr. interval on outer sheath.</p> <p>Vendor has to furnish resistance / reactance / capacitances of the cable</p>
	<p><b><u>Rating:</u></b></p> <p>Up to and including 1100 Volts.</p>
	<b><u>DRAWINGS &amp; INFORMATION</u></b>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	Contractor shall submit the as built drawing of the cable laying drawing.
	HANDINGOVER DOCUMENTS
	<p>The supplier shall submit following:</p> <ol style="list-style-type: none"> <li>1. Data sheet indicating results of tests</li> <li>2. Test reports</li> </ol>
	<b><u>INSPECTION AND TESTING</u></b>
	<p>All cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal conditions of handling during transportation, loading, unloading etc.</p> <p>The cable shall be supplied in single length i.e. without any intermediate joint or cut unless specifically approved by the client.</p> <p>The cable ends shall be suitably sealed against entry of moisture, dust, water etc. with cable compound as per standard practice.</p>
	<p><b><u>Finished Cable Tests at Manufacturer's Works:</u></b></p> <p>The finished cables shall be tested at manufacturer's works. Following routine tests for each and every length of cable and copy of test results shall be furnished for each length of cable along with supply. If specified, the cables shall be tested in presence of client's representative.</p>
	<p><b><u>Voltage Test:</u></b></p> <p>Each core of cable shall be tested at room temperature at 3 KV A.C. R.M.S. for duration of 5 minutes.</p>
	<p><b><u>Conductor Resistance Test:</u></b></p> <p>The D.C. Resistance of each conductor shall be measured at room temperature and the results shall be corrected to 20° c. to check the compliance with the values specified in IS 8130 - 1976.</p>
	<b><u>Cable Test Before and After Laying of Cables at Site</u></b>
	Insulation Resistance test between phases and phase to Neutral and phase to earth.
	Continuity test of all the phases, neutral and earth continuity conductor.
	Sheathing continuity test.
	Earth resistance test of all the phases and neutral.
<b>7.0</b>	<b><u>METHOD OF MEASUREMENT</u></b>
	The cables will be measured in meters. The unit rate shall include cutting the cable into required lengths, packing, loading, unloading, insurance, transportation, delivery to stores/site as per work order, stocking in stores, testing of cables at stores etc. of medium voltage cable. Total quantity in

<p align="center"><b><u>TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS</u></b></p>
---

	meters shall be measured lug to lug basis.
<b>8.0</b>	<b><u>TRANSPORT, DELIVERY AND STORAGE</u></b>
	The cable shall be supplied in the actual length as per detailed purchase order
	The cable shall be dispatched at client's stores or at site as per detailed instructions given by client at later stage.
	The cable shall be loaded from the main vendor's store and properly stacked as per instruction of client's local representative. All such labour and transportation charges shall be clearly mentioned in the offer.
<b>9.0</b>	<b><u>GUARANTEE OF PERFORMANCE</u></b>
	The quotes values of parameters shall be within given tolerance for given period of service life.
<b>10.0</b>	<b><u>SPARES</u></b>
<b>10.1</b>	As per standard and as per specified by site engineers/contractor/client.

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>2.0 TECHNICAL SPECIFICATIONS FOR INTERNAL WIRING</b>																																																			
<b>1.0</b>	<b><u>SCOPE OF WORK</u></b>																																																		
	This section covers, definition of point wiring, system of wiring and supply, installation, connection, testing and commissioning of point wiring for light points, ceiling fan points, exhaust fan points, convenience socket outlet points, power socket outlet points, bell outlet points etc. including fixing of light fixtures, ceiling fan, exhaust fan, wall fan, bell etc																																																		
<b>2.0</b>	<b><u>CODES &amp; STANDARDS</u></b>																																																		
	The following standards and rules shall be applicable:																																																		
	<table border="1"> <thead> <tr> <th>Sr. No.</th><th>Item</th><th>Relevant IS</th><th>Relevant IEC</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Code of practice for electrical wiring installation (System voltage not exceeding 650 V)</td><td>IS: 732</td><td></td></tr> <tr> <td>2.</td><td>Code of practice for fire safety of buildings (General) Electrical installation.</td><td>IS: 1646</td><td></td></tr> <tr> <td>3.</td><td>Rigid steel conduits for electrical wiring.</td><td>IS: 9537 (Part - 2)</td><td></td></tr> <tr> <td>4.</td><td>Fittings for rigid steel conduits for electrical wiring.</td><td>IS: 2667</td><td></td></tr> <tr> <td>5.</td><td>Flexible steel conduits for Electrical wiring.</td><td>IS: 3480</td><td></td></tr> <tr> <td>6.</td><td>Accessories for rigid steel conduit for electrical wiring.</td><td>IS: 3837</td><td></td></tr> <tr> <td>7.</td><td>PVC insulated cables.</td><td>IS: 694</td><td></td></tr> <tr> <td>8.</td><td>Rigid non-metallic conduits for electrical wiring.</td><td>IS: 9537 (Part - 3)</td><td></td></tr> <tr> <td>9.</td><td>Flexible (Pliable) non-metallic conduits for electrical installation.</td><td>IS: 6946</td><td></td></tr> <tr> <td>10.</td><td>3 pin plugs and sockets.</td><td>IS: 1293</td><td></td></tr> <tr> <td>11.</td><td>Specifications of conduits for electrical installation.</td><td>IS: 8130</td><td></td></tr> </tbody> </table>	Sr. No.	Item	Relevant IS	Relevant IEC	1.	Code of practice for electrical wiring installation (System voltage not exceeding 650 V)	IS: 732		2.	Code of practice for fire safety of buildings (General) Electrical installation.	IS: 1646		3.	Rigid steel conduits for electrical wiring.	IS: 9537 (Part - 2)		4.	Fittings for rigid steel conduits for electrical wiring.	IS: 2667		5.	Flexible steel conduits for Electrical wiring.	IS: 3480		6.	Accessories for rigid steel conduit for electrical wiring.	IS: 3837		7.	PVC insulated cables.	IS: 694		8.	Rigid non-metallic conduits for electrical wiring.	IS: 9537 (Part - 3)		9.	Flexible (Pliable) non-metallic conduits for electrical installation.	IS: 6946		10.	3 pin plugs and sockets.	IS: 1293		11.	Specifications of conduits for electrical installation.	IS: 8130			
Sr. No.	Item	Relevant IS	Relevant IEC																																																
1.	Code of practice for electrical wiring installation (System voltage not exceeding 650 V)	IS: 732																																																	
2.	Code of practice for fire safety of buildings (General) Electrical installation.	IS: 1646																																																	
3.	Rigid steel conduits for electrical wiring.	IS: 9537 (Part - 2)																																																	
4.	Fittings for rigid steel conduits for electrical wiring.	IS: 2667																																																	
5.	Flexible steel conduits for Electrical wiring.	IS: 3480																																																	
6.	Accessories for rigid steel conduit for electrical wiring.	IS: 3837																																																	
7.	PVC insulated cables.	IS: 694																																																	
8.	Rigid non-metallic conduits for electrical wiring.	IS: 9537 (Part - 3)																																																	
9.	Flexible (Pliable) non-metallic conduits for electrical installation.	IS: 6946																																																	
10.	3 pin plugs and sockets.	IS: 1293																																																	
11.	Specifications of conduits for electrical installation.	IS: 8130																																																	



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

		<b>12.</b>	Switches for domestic purpose.	IS: 3854																																													
		<b>13.</b>	Fittings for rigid non-metallic conduits.	IS: 3419																																													
		<b>14.</b>	Guide for electrical layout in residential buildings Indian electricity act and rules.	IS: 4648																																													
<b>3.0</b>	<b><u>DESIGN BASIS &amp; SITE CONDITIONS</u></b>																																																
	All the equipment and components provided in the transformer and accessories shall be suitably designed for installation and satisfactory operation as specified below.																																																
		<table><tr><td colspan="4"><b>Electrical system data:</b></td></tr><tr><td colspan="4"><b>Power supply for Equipment</b></td></tr><tr><td colspan="2">Voltage 415 V ± 5 %</td><td colspan="2">Frequency 50 Hz ± 3 %</td></tr><tr><td><b>Permissible combined voltage &amp; frequency variation</b></td><td>± 6 %</td><td><b>System design faults level (Symmetrical)</b></td><td>35 kA for 1 sec. max.</td></tr><tr><td colspan="2"><b>System earthing</b> LV side neutral solidly earthed</td><td colspan="2"><b>Wiring</b> 3 phase, 4 wire on 415V system</td></tr><tr><td colspan="4"><b>Auxiliary power supply :</b></td></tr><tr><td colspan="2"><b>Power supply</b></td><td colspan="2">240V AC, 1-Ph, 50Hz</td></tr><tr><td colspan="2"><b>Control Supply</b></td><td colspan="2">-----</td></tr><tr><td colspan="2"><b>Space heater power supply</b></td><td colspan="2">240V AC, 1-Ph, 50Hz</td></tr><tr><td colspan="2"><b>Illumination power supply</b></td><td colspan="2">240V AC, 1-Ph, 50Hz</td></tr><tr><td colspan="2"><b>Plug-socket power supply</b></td><td colspan="2">240V AC, 1-Ph, 50Hz</td></tr></table>				<b>Electrical system data:</b>				<b>Power supply for Equipment</b>				Voltage 415 V ± 5 %		Frequency 50 Hz ± 3 %		<b>Permissible combined voltage &amp; frequency variation</b>	± 6 %	<b>System design faults level (Symmetrical)</b>	35 kA for 1 sec. max.	<b>System earthing</b> LV side neutral solidly earthed		<b>Wiring</b> 3 phase, 4 wire on 415V system		<b>Auxiliary power supply :</b>				<b>Power supply</b>		240V AC, 1-Ph, 50Hz		<b>Control Supply</b>		-----		<b>Space heater power supply</b>		240V AC, 1-Ph, 50Hz		<b>Illumination power supply</b>		240V AC, 1-Ph, 50Hz		<b>Plug-socket power supply</b>		240V AC, 1-Ph, 50Hz	
<b>Electrical system data:</b>																																																	
<b>Power supply for Equipment</b>																																																	
Voltage 415 V ± 5 %		Frequency 50 Hz ± 3 %																																															
<b>Permissible combined voltage &amp; frequency variation</b>	± 6 %	<b>System design faults level (Symmetrical)</b>	35 kA for 1 sec. max.																																														
<b>System earthing</b> LV side neutral solidly earthed		<b>Wiring</b> 3 phase, 4 wire on 415V system																																															
<b>Auxiliary power supply :</b>																																																	
<b>Power supply</b>		240V AC, 1-Ph, 50Hz																																															
<b>Control Supply</b>		-----																																															
<b>Space heater power supply</b>		240V AC, 1-Ph, 50Hz																																															
<b>Illumination power supply</b>		240V AC, 1-Ph, 50Hz																																															
<b>Plug-socket power supply</b>		240V AC, 1-Ph, 50Hz																																															
<b>4.0</b>	<b><u>TECHNICAL REQUIREMENTS</u></b>																																																
	<b>POINT WIRING</b>																																																
	A point shall consist of the branch wiring from the distribution board together with a switch as required, including the ceiling rose or pendant holder or swan holder, or ceiling fan box or socket or suitable termination. A point shall include, in addition, the earth continuity conductor/wire from the																																																

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	distribution board to the earth pin/stud of the outlet/switch box and to the outlet points
	Supply, installation, fixing of conduits with necessary accessories, junction/pull/inspection/switch boxes and outlet boxes
	Supplying and drawing of wires of required size including earth continuity wire
	Supply, installation and connection of flush type switches, sockets, cover plates, switch plates, and fixing fan regulator etc.
	The point shall be complete with the branch wiring from the distribution board to the outlet point, through switch board, conduit with accessories, junction, pull, inspection boxes, control switch, socket, outlet boxes, ceiling roses, button/swan holder, connector etc.
<b>4.2</b>	<b>POINT RATE</b>
	The rate per point shall include supply, installation, connection, testing and commissioning of point as described under "point wiring". The measurements of the points will be enumerated
<b>4.3</b>	<b>SYSTEM OF WIRING</b>
	<p>Unless otherwise mentioned on the drawings, the system of point wiring shall be as follows:</p> <p>The system of wiring shall consist of single core, FRLS insulated, 650/1100 volt grade, copper conductor wires/cables laid through exposed (surface mounted) PVC conduits as directed &amp; wherever required, conduits shall be concealed in walls and slabs</p>
<b>4.4</b>	<b>GENERAL</b>
	Prior to laying of conduits, the contractor shall submit for approval, the shop drawing for conduit layout indicating the route of the conduits, number and size of the conduits, location of junction/inspection/pull/outlet boxes, size and location of switch boxes, number and size of wires pulled through each conduit and all other necessary relevant details. Only after the drawings are approved, the contractor shall proceed with the work of laying of conduits.
<b>4.5</b>	<b>MATERIAL</b>
	<p>PVC Conduit</p> <p>All non-metallic PVC conduits shall conform to IS: 9537 ( Part - 3 ). The conduit shall be planed and of type as specified in IS: 9537 and shall be used with the corresponding accessories (Refer IS: 3419 specification for fittings for rigid non-metallic conduits). PVC conduits shall be rigid unplasticised, heavy gauge having 2.0 mm. wall thickness upto 20 mm. diameter conduit and 2.5 mm. wall thickness for all sizes above 20 mm. diameter</p>
<b>4.5.2</b>	<b>M.S. CONDUIT</b>
	<p>Conduits shall conform to IS: 9537 (Part - 2), finished with galvanized surface. No steel conduit less than 25 mm. in diameter shall be used. Conduits shall be solid drawn of lap welded type, with minimum wall thickness for conduits having 25 mm. and above diameter</p> <p>The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of manufacturers</p> <p>The conduit accessories such bends, coupling etc. shall be conforming to the relevant Indian</p>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	Standard specification						
<b>4.5.3</b>	<p><b>BOXES</b></p> <ol style="list-style-type: none"> <li>1. All the boxes for switches, sockets and other receptacles, junction boxes, pull boxes and outlet boxes shall be fabricated from 2.0 mm. thick mild sheet painted with two coats of red-oxide and then two coats of enamel paints as called for. Colour of the paints shall be as approved by the client. The boxes shall have smooth external and internal finished surface</li> <li>2. Boxes in contact with earth or exposed to the weather shall be of 2 mm. mild steel and hot dip galvanized after fabrication</li> <li>3. Separate screwed earth terminal shall be provided in the box for earthing purpose</li> <li>4. All boxes shall have adequate no. of knock out holes of required diameter for conduit entry</li> <li>5. Switch boxes to receive switches, socket outlets, power outlets, telephone outlets, fan regulators, etc. shall be fabricated to the approved shape and size to accommodate all the devices without overcrowding.</li> <li>6. Outlet boxes to receive ceiling fan shall be fitted with adequately sized rod</li> <li>7. Hook to fix ceiling fan. The boxes shall be of minimum depth of 65 mm.</li> <li>8. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers as required. Boxes for use in masonry block or tiled walls shall be square cornered tile type, or standard boxes having square cornered tile type covers. These boxes shall be installed in the center of the masonry block or tiles</li> <li>9. Cast metal boxes installed in wet locations and boxes installed flush with the outside of exterior surface shall be gasketed</li> </ol>						
<b>4.5.4</b>	<p><b>COVER PLATE</b></p> <p>The cover of the boxes to receive outlet points shall be of best anodized sheet cut to shape and size or plate of approved manufacturers of switches</p>						
<b>4.5.5</b>	<p><b>CABLES</b></p> <ol style="list-style-type: none"> <li>1. The cables shall conform to IS: 694. For all internal wiring FRLS insulated cables of 650/1100 volts grade, single core shall be used</li> <li>2. The conductors shall be plain annealed copper conductors complying with IS: 1554</li> <li>3. The conductors shall be circular copper conductor</li> <li>4. The insulation shall be FRLS compound complying with the requirements of IS: 694. It shall be applied by an extrusion process and shall form a compact homogenous body.</li> <li>5. The thickness of FRLS insulation shall be as set out in the relevant standards</li> <li>6. The cores of all cables shall be identified by colours in accordance with the following sequence.</li> </ol> <table border="1" style="margin-left: 40px;"> <tr> <td>Single phase</td><td>Red</td></tr> <tr> <td>Three phase</td><td>Red, Yellow, Blue</td></tr> <tr> <td>Neutral</td><td>Black</td></tr> </table>	Single phase	Red	Three phase	Red, Yellow, Blue	Neutral	Black
Single phase	Red						
Three phase	Red, Yellow, Blue						
Neutral	Black						

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<table border="1"> <tr> <td>Earth</td><td>Green or Green/Yellow</td></tr> </table> <p>7. Means of identifying the manufacturer shall be provided throughout the length of cable</p> <p>8. Unless otherwise specified in the drawings the size of the cables used for internal wiring shall be as follows:</p> <ul style="list-style-type: none"> <li>In case of circuit wiring for lights, exhaust fans, ceiling fans, bell, convenience socket outlet points (P+N+E): <table border="1"> <tr> <td>2.5sq.mm.</td><td>From D.B. to switch boards.</td></tr> <tr> <td>1.5sq.mm.</td><td>From switch boards to outlet points</td></tr> </table> </li> <li>In case of power socket outlet circuit having not more than two 15 A power outlet (P+N+E): <table border="1"> <tr> <td>4.0sq.mm.</td><td>From D.B. to first power outlet</td></tr> <tr> <td>2.5sq.mm.</td><td>From first power outlet to second power outlet</td></tr> </table> </li> <li>In case of power socket outlet circuit having single 15 A power outlet (like water heater) (P+N+E): <table border="1"> <tr> <td>4.0sq.mm.</td><td>From D.B. to power outlet.</td></tr> </table> </li> <li>In case of 15 A. power outlet for window Air conditioner or other likewise appliances (P+N+E): <table border="1"> <tr> <td>4.0sq.mm.</td><td>From D.B. to power outlet.</td></tr> </table> </li> </ul> <p>The earth continuity conductor shall be similar to circuit cables and shall be drawn through conduit along with other circuit cables. The size of the earth continuity conductor shall be as follows:</p> <p><b><u>MINIMUM SIZE OF EARTH CONTINUITY CONDUCTOR NOT FORMING PART OF THE SAME CABLE AS THE ASSOCIATE CIRCUIT CONDUCTOR</u></b></p> <table border="1"> <tr> <td>Nominal cross-section area of largest associated copper circuit conductor in sq.mm</td><td>Nominal cross-sectional area of earth continuity conductor in sq.mm.</td></tr> <tr> <td>1.5</td><td>1.5</td></tr> <tr> <td>2.5</td><td>2.5</td></tr> <tr> <td>4.0</td><td>4.0</td></tr> </table> <p>Separate circuit shall run for each water heater, kitchen equipment, window air conditioner, and similar outlets at location as shown on drawing</p>	Earth	Green or Green/Yellow	2.5sq.mm.	From D.B. to switch boards.	1.5sq.mm.	From switch boards to outlet points	4.0sq.mm.	From D.B. to first power outlet	2.5sq.mm.	From first power outlet to second power outlet	4.0sq.mm.	From D.B. to power outlet.	4.0sq.mm.	From D.B. to power outlet.	Nominal cross-section area of largest associated copper circuit conductor in sq.mm	Nominal cross-sectional area of earth continuity conductor in sq.mm.	1.5	1.5	2.5	2.5	4.0	4.0
Earth	Green or Green/Yellow																						
2.5sq.mm.	From D.B. to switch boards.																						
1.5sq.mm.	From switch boards to outlet points																						
4.0sq.mm.	From D.B. to first power outlet																						
2.5sq.mm.	From first power outlet to second power outlet																						
4.0sq.mm.	From D.B. to power outlet.																						
4.0sq.mm.	From D.B. to power outlet.																						
Nominal cross-section area of largest associated copper circuit conductor in sq.mm	Nominal cross-sectional area of earth continuity conductor in sq.mm.																						
1.5	1.5																						
2.5	2.5																						
4.0	4.0																						
<b>4.5.6</b>	<p><b>SWITCHES</b></p> <p>1. Switches shall conform to IS: 3854, IS: 1293 and IS: 4615. The switches shall be single pole,</p>																						

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p>single or two way as shown on the drawings or as specified. They shall be of moulded type rated for 250 volt, and of full 5/15 A capacity. They shall be provided with insulated dollies and covers</p> <ol style="list-style-type: none"> <li>The switches shall be rocker operated with a quiet operating mechanism with bounce free snap action mechanism enclosed in an arc resistant chamber.</li> <li>The switches shall have pure silver and silver cadmium contacts.</li> <li>The switches shall be flush modular type.</li> <li>The make of the switches shall be as indicated in the drawings or BOQ or make of material or as suggested and approved by the client.</li> <li>The switches installed in outdoor area shall be industrial, metal clad type, and shall be provided in weather proof enclosures, complete with weather proof gasketed covers.</li> </ol>
	<p><b>SOCKETS</b></p> <ol style="list-style-type: none"> <li>The sockets shall conform to IS: 1293. Each socket shall be provided with control switch of appropriate rating. The sockets shall be moulded type, rated for 250 volts, and either of full 5 A or 15 A capacity, as mentioned on the drawings.</li> <li>Sockets shall be of three pin type, the third in being connected to earth continuity conductor.</li> <li>The socket shall be flush modular type.</li> <li>The sockets installed in machine room, plant room or wet/damp area shall be metal clad weather proof type.</li> <li>The finishing and make of all the sockets shall be same as light switch.</li> <li>The socket shall have fully sprung contacts and solid brass shrouded</li> <li>Terminals to ensure positive electrical connections.</li> <li>The sockets shall be provided with automatic shutters, which open only when earth pin of the plug inserts in the socket.</li> <li>The socket shall be provided with three pin plug top suitable to the socket and of the same make as socket.</li> </ol>
<b>5.0</b>	<b><u>DRAWINGS &amp; INFORMATION</u></b>
	<b>N.A.</b>
<b>6.0</b>	<b><u>INSPECTION AND TESTING</u></b>
	<b>INSULATION RESISTANCE TEST</b>
	The insulation resistance shall be measured by applying 500 volt megger with all fuses in places, circuit breaker and all switches closed
	The insulation resistance in megohms of an installation, measured shall not be less than 50 megohms divided by the number of points on the circuit
	<p>The insulation resistance shall be measured between:</p> <ol style="list-style-type: none"> <li>EARTH TO PHASE</li> <li>EARTH TO NEUTRAL</li> </ol>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<b>3. PHASE TO NEURAL</b> <b>4. PHASE TO PHASE</b>
<b>6.2</b>	<b>EARTH CONTINUITY PATH</b>
	The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker, measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm
<b>6.3</b>	<b>POLARITY OF SINGLE POLE SWITCHES</b>
	A test shall be made to verify that every no-linked, single pole switch is connected to one of the phase of the supply system
<b>6.4</b>	<b>COMPLETION CERTIFICATES</b>
	All the above tests shall be carried out in presence of client and the results shall be recorded in prescribed forms. Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result from shall be submitted to the client for approval
	On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.
<b>7.0</b>	<b><u>INSTALLATION OF THE SYSTEM</u></b>
	<b>CONCEALED INSTALLATION WITH RIGID PVC CONDUIT</b>
	All the rigid PVC conduit used for concealed installation shall be as per IS ; 9537 and its accessories shall be as per IS: 3419 (Small Wire Ropes).
	Whenever necessary bends or diversion may be achieved by bending the conduits with the help of bending spring. No other method of bending is allowed
	Conduit pipes shall be joined with the help of plain coupler fixed at the end with the help of vinyl solvent cement. No other method of joining is permissible
	All other methods, no wires through conduit, bunching, etc. Shall be as specified in the concealed installation
	Prior to fixing the conduits, the complete route shall be marked on site for the approval of consultant
<b>7.2</b>	<b>CONCEALED WIRING SYSTEM WITH RIGID PVC CONDUIT</b>
	The rigid PVC conduits shall be used for concealed wiring system. The conduits shall be concealed in the concrete slab, floor, walls, beams, columns etc
	<b>FIXING OF CONDUIT</b>
	1. Conduits embedded in concrete shall be installed in the frame work before pouring concrete. The conduits shall be installed above the bottom reinforcing bars, and shall provide positive

wire fastening of the conduit to the reinforcing rods at an interval of not more than one meter, but on either side of couplers or bends or putlet/pull/junction boxes or similar fittings, proper hold fast shall be fixed at a distance of 30 cm from the center of such fittings. Conduits embedded in the wall shall be fixed inside the chase. The chase in the wall shall be neatly made and be fixed in the manner desired. In the case of building under construction, chase shall be provided in the wall at the time of their construction and shall be filled up neatly with cement mortar 1:4 after erection of conduit and brought to the original finish of the wall. Cutting of horizontal chases in walls is prohibited. The conduits shall be fixed inside the chase by means of staples or by means of saddles not more than 60 cm apart.

2. Conduits shall be so arranged as to facilitate easy drawing of wires through them. Entire conduit layout shall be done in such a way as to avoid additional junction boxes other than light points. The wiring shall be done in a looping manner. All the looping shall be done in either switch boxes or outlet boxes. Looping in junction or pull boxes are strictly not allowed. Where conduits cross building expansion joints, adequate expansion fittings or other approved devices shall be used to take care of any relative movement
  3. All conduits shall be installed so as to avoid steam and hot water pipes
  4. Conduits shall be installed in such a way that the junction, derivation and pull boxes shall always be accessible for repairs and maintenance work. The location of junction/pull boxes shall be marked on the shop drawings and approved by the client
  5. A separation of 200 mm shall be maintained between electrical conduits and hot water lines in the building
  6. No run of conduit shall exceed ten mtr. between adjacent draw in points nor shall it contain more than two right angle bends, or other derivation from the straight line
  7. Caution shall be exercised in using the PVC conduits in location where ambient temperature is 50 degree cel. or above. Use of PVC conduits in places where ambient temperature is more than 60 deg. cel. is prohibited. The entire conduit system including boxes shall be thoroughly cleaned after completion of installations and before drawing of wires. Conduit system shall be erect and straight as far as possible. Traps where water may accumulate from condensation are to be avoided and if unavoidable, suitable provision for draining the water shall be made
1. All jointing method shall be subject to the approval of the client
  2. Separate conduits shall be provided for the following system.
    - 15 A power outlets.
    - 5 A outlets and lighting system.
    - Low voltage system.
    - Telephone/intercom system.
    - C.C.T.V. system
    - Sound system
    - Computer data cabling system
    - Equipment wiring

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>7.3</b>	<b>CONDUIT JOINT</b>				
	<ol style="list-style-type: none"> <li>1. Conduits shall be joined by means of plain couplers vinyl and/or solvent cement. Where there are long runs of straight conduit, inspection type couplers shall be provided at intervals , as approved by the client</li> <li>2. The conduits shall be thoroughly cleaned before making the joints</li> <li>3. In case of plain coupler joints, proper jointing material like vinyl solvent cement (gray in color) or any material as recommended by the manufacturer shall be used.</li> </ol>				
<b>7.4</b>	<b>BENDS IN CONDUIT</b>				
	Wherever necessary, bends or diversions may be achieved by bending the conduits or by employing normal bends. No bends shall have radius less than 2.5 times outside dia. of the conduit				
	Heat may be used to soften the PVC conduit for bending, but while applying heat to conduit, the conduit shall be filled with sand to avoid any damage to the conduit				
<b>7.3</b>	<b>OUTLETS</b>				
	All the outlets for fittings, switches etc. shall be boxes of substantial construction				
	In order to minimize condensation or sweating inside the conduits, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects , etc.				
	Fixing between conduit and boxes, outlet boxes, switch boxes and the like must be provided with entry spouts and smooth PVC bushes.				
	Joints between conduit and any type of boxes shall be affected by means of conduit couplers in to each of which shall be coupled smooth PVC bush from inside the box. In any case all the joints shall be fully water tight.				
<b>7.4</b>	<b>BUNCHING OF CABLES</b>				
	Cables of AC supply of different phase shall be bunched in separate conduits				
	<p>The number of insulated wires/ cables that may be drawn into the conduits shall be as per the following table. In this table, the space factor does not exceed 40%. However, in any case conduits having lesser than 19 mm dia. shall not be used.</p> <p>MAXIMUM PERMISSIBLE NUMBER OF 650 VOLT GRADE SINGLE CORE CABLES THAT MAY BE DRAWN IN TO RIGID PVC CONDUITS.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">CABLE SIZE IN MM SQ.</th><th style="width: 70%;">SIZE OF CONDUITS (MM)</th></tr> </thead> <tbody> <tr> <td style="height: 40px;"></td><td></td></tr> </tbody> </table>	CABLE SIZE IN MM SQ.	SIZE OF CONDUITS (MM)		
CABLE SIZE IN MM SQ.	SIZE OF CONDUITS (MM)				



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

			MAXIMUM NO. OF CABLES			
			25	32	38/40	51/50
		1.5	8	15	---	---
		2.5	6	10	---	---
		4.0	4	8	12	---
7.5	WIRING WITH RIGID STEEL CONDUIT					
	All conduits and it's accessories shall be of threaded type and under no circumstances pin grip type or clamp type accessories be used					
7.6	FIXING OF CONDUIT					
	Conduit pipes shall be fixed by heavy gauge spacer bar saddles. The saddles shall be of 3 mm x 19 mm galvanized mild steel flat, properly treated and securely fixed to support by means of nuts and bolts raw bolts, brass machine screws, as mentioned, at an interval of not more than one meter but on either side of couplers, or bends, or junction/pull/outlet boxes or similar fittings, saddles shall be fixed at a distance of 30 cm from the centre of such fittings.					
	Draw boxes shall be located at convenient location for easy drawing of wires					
	Every mains and sub mains shall run in independent conduits with an independent earth wire of specified capacity along the entire length of conduit					
	The conduits to be installed shall be of ample cross section area to facilitate the drawing of wires. The diameter of the conduit shall be selected as per table specified in these specifications. But in no case it shall be less than 25 mm diameter					
	Entire conduit layout shall be done such as to avoid additional junctions boxes other than for outlet points. Conduits shall be free from sharp edge and burrs. Conduits shall be laid in a neat and organized manner as directed and approved by the client. Conduit runs shall be planned so as not to conflict with any other services pipe, lines/duct					
	The entire conduit system shall be electrically and mechanically continuous and shall be bonded, together by means of approved type earthing clamp and earthed through a bare copper conductor of 14 SWG to the earthing terminals on the nearest distribution board					
	If required, connection between PVC and steel conduits shall be through a junction box. Direct connection between PVC and steel conduits are not allowed					
	Where exposed conduits are suspended from the structure, they shall be clamped firmly and rigidly to hangers of design to be approved by client. Where hangers are to be anchored to reinforced concrete, appropriate inserts and necessary devices for their fixing shall be left in position at the time of concreting, making holes and opening in the concrete will generally not be allowed. In case, it is unavoidable, prior permission of the client shall be obtained					

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>7.7</b>	<b>CONDUIT JOINTS</b>
	Conduit pipes shall be joined by means of screwed couplers and screwed accessories, as per IS: 2667
	The threads shall be free from grease or oil
	In long distanced straight runs of conduit, inspection type couplers two way junction boxes at reasonable intervals shall be provided or running threads with couplers and lock nuts shall be provided. The bare threaded portion shall be treated with anti-corrosive paints. Threads on conduit pipes in all cases shall be between 11mm to 27mm long, sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges nor any burrs left, to avoid damage to the insulation of conductors while pulling them through such pipes
	Brass female bushes shall be used in each conduit termination in a switch box, outlet box, electrical panel or any other box
	Conduit shall be secured in each outlet box switch box, electrical panel or any other box by means of one brass hexagonal lock nut and bush, outside and inside the box
	At each building, expansion joints approved oil tight double wire wound flexible steel conduit or any other approved method shall be used. This shall be united on both sides with the rigid conduits by suitable union
	Conduits installed in the plant room for mechanical equipment shall be properly clamped with the mechanical supports, but in no case, it shall be fixed with the body of the equipment
	The connection of conduit to the mechanical equipment shall be through oil tight double wire wound flexible steel conduit. In any case the length of the flexible conduit shall not exceed one meter. The flexible conduit shall be properly clamped with the body of the equipment. They shall not in any case be clamped with any cover or any removable parts of the equipment
<b>7.8</b>	<b>BENDS IN CONDUIT</b>
	All necessary bends in the system including diversion shall be done by bending pipes or by inserting suitable solid or circular inspection type normal box or similar fittings. Conduit fittings shall be avoided as far as possible on conduit system exposed to weather, where necessary, solid type fittings shall be used. Radius of such bends in conduit pipes shall be not less than 75 mm. No length of conduit shall have more than the equivalent of four quarter bends from outlet, the bends at the outlets not being counted
<b>7.9</b>	<b>PROTECTION AGAINST DAMPNESS</b>
	In order to minimize condensation or sweating inside the conduit, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects, as far as possible
<b>7.10</b>	<b>PROTECTION OF CONDUIT AGAINST RUST</b>
	The outer surface of the conduits including bends, junction boxes, etc., forming part of the conduit system shall be adequately protected against rust, particularly when such system is exposed to weather. In all cases, no bare/threaded portion of conduit pipe shall be allowed unless such bare

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	threaded portion is treated with anti-corrosive coating or covered with approved plastic compound																														
7.11	<b>BUNCHING OF CABLES</b>																														
	<p>Unless otherwise specified, insulated conductors of different phases shall be bunched in separate conduit.</p> <p>Wires carrying current shall be so bunched in the conduit that the out going and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit</p>																														
	<p>The number of insulated wires/cables that be drawn into the conduits shall be as per the following table.</p> <p>MAXIMUM PERMISSIBLE NUMBER OF 650/1100 VOLTS GRADE SINGLE CORE CABLE THAT CAN BE DRAWN INTO RIGID STEEL CONDUITS.</p> <table><tr><th>CABLE SIZE IN MM SQ.</th><th colspan="4">SIZE OF CONDUITS (MM)</th></tr><tr><td></td><th colspan="4">MAXIMUM NO. OF CABLES</th></tr><tr><td></td><td>25</td><td>32</td><td>38</td><td>51</td></tr><tr><td>1.5</td><td>10</td><td>14</td><td>---</td><td>---</td></tr><tr><td>2.5</td><td>8</td><td>12</td><td>---</td><td>---</td></tr><tr><td>4.0</td><td>6</td><td>10</td><td>---</td><td>---</td></tr></table>	CABLE SIZE IN MM SQ.	SIZE OF CONDUITS (MM)					MAXIMUM NO. OF CABLES					25	32	38	51	1.5	10	14	---	---	2.5	8	12	---	---	4.0	6	10	---	---
CABLE SIZE IN MM SQ.	SIZE OF CONDUITS (MM)																														
	MAXIMUM NO. OF CABLES																														
	25	32	38	51																											
1.5	10	14	---	---																											
2.5	8	12	---	---																											
4.0	6	10	---	---																											
7.12	<b>SWITCH AND SOCKET</b>																														
	Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings																														
	The switch controlling the light point or fan shall be connected on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators shall be fixed inside the switch boxes on adjustable flat M.S. strips/plates with tapped holes and brass machine screws, leaving ample space at the back and side for accommodating wires																														
	The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws																														
	Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets and regulators																														
	The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit																														

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission
<b>7.13</b>	<b>DRAWING OF CONDUCTORS</b>
	The drawing and joining of copper conductor or wires shall be executed with due regard to the following precautions. While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. There shall be no sharp bends
	Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or ringing
	FRLS insulated copper conductor wire ends before connection shall be properly soldered (at least 15 mm length) with soldering flux/copper solder, for copper conductor. Strands of wires shall not be cut for connecting to the terminals. All strands of wires shall be soldered at the terminals. All strands of wires shall be soldered at the end before connection. The connecting brass-screws shall have flat ends. All looped joints shall be soldered and connected through terminals block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. Conductors having nominal cross section exceeding 4 sq. mm shall always be provided with crimping type cable sockets. At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used. Brass nuts and bolts shall be used for all connections
	Only certified wire men and cable jointers shall be employed to do joining work
	For all internal wiring FRLS insulated wires of 650/1100 volts grade shall be used. The sub-circuit wiring for point shall be carried out in looping system and no joint shall be allowed in the length of the conductors. No wire shall be drawn in to any conduit, until all work of any nature that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Before the wires are drawn into the conduits the conduits shall be thoroughly cleaned of moisture, dust, and dirt or any other obstruction by forcing compressed air through the conduits
<b>7.14</b>	<b>JOINTS</b>
	The wiring shall be by looping back system, and hence all joints shall be made at main switches, distribution boards, socket outlets, lighting outlets and switch boxes only. No joints shall be made inside conduits and junction boxes.
	Contractors shall be continuous from outlet to outlet. For joints where unavoidable, due to any specified reasons, prior permission in writing shall be obtained from the client before making such connections. Joints by twisting conductors are prohibited.
<b>7.15</b>	<b>LOAD BALANCING</b>
	Balancing of circuit in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.
<b>7.16</b>	<b>EARTHING</b>
	All earthing systems shall be in accordance with IS: 3043 - 1985 code of practice for earthing

3.0	<b><u>TECHNICAL SPECIFICATIONS FOR LIGHTING DISTRIBUTION BOARDS</u></b>																							
1.0	<b><u>SCOPE OF WORK</u></b>																							
	This section relates to specifications for supply of lighting distribution board (LDB) & Power distribution board (PDB) TPN/FP/DP/SP MCB isolator & ELMCB, Earthing terminal, connector strip for phase neutral and earth for each circuit, CRCA sheet steel housing and complete the item supply. Common banking of neutral and earth conductor is not allowed.																							
2.0	<b><u>CODES &amp; STANDARDS</u></b>																							
	The Distribution Board shall comply with the latest edition of relevant Indian Standards and Indian Electricity Rules and Regulations. The following Indian standards shall be complied with:																							
	<table><tr><th>Sr. No.</th><th>Item</th><th>Relevant IS</th><th>Relevant IEC</th></tr><tr><td>1.</td><td>General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC</td><td>IS: 4237</td><td></td></tr><tr><td>2.</td><td>Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.</td><td>IS: 375</td><td></td></tr><tr><td>3.</td><td>Terminal marking for electrical measuring instrument and their accessories.</td><td>IS: 8197</td><td></td></tr><tr><td>4.</td><td>Miniature circuit breakers.</td><td>IS: 8828</td><td></td></tr></table>				Sr. No.	Item	Relevant IS	Relevant IEC	1.	General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC	IS: 4237		2.	Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.	IS: 375		3.	Terminal marking for electrical measuring instrument and their accessories.	IS: 8197		4.	Miniature circuit breakers.	IS: 8828	
Sr. No.	Item	Relevant IS	Relevant IEC																					
1.	General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC	IS: 4237																						
2.	Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.	IS: 375																						
3.	Terminal marking for electrical measuring instrument and their accessories.	IS: 8197																						
4.	Miniature circuit breakers.	IS: 8828																						
3.0	<b><u>DESIGN BASIS &amp; SITE CONDITIONS</u></b>																							
	All the equipment and components provided in the DB and accessories shall be suitably designed for installation and satisfactory operation as specified below.																							
	<table><tr><td colspan="4">Electrical system data:</td></tr><tr><td colspan="4">Power supply for Equipment</td></tr><tr><td colspan="2">Voltage 415 V ± 5 %</td><td colspan="2">Frequency 50 Hz ± 3 %</td></tr><tr><td>Permissible combined voltage &amp; frequency variation</td><td>± 6 %</td><td>System design faults level (Symmetrical)</td><td>10 kA for 1 sec. max.</td></tr><tr><td colspan="2">System earthing LV side neutral solidly</td><td colspan="2">Wiring 3 phase, 4 wire on 415V system</td></tr></table>				Electrical system data:				Power supply for Equipment				Voltage 415 V ± 5 %		Frequency 50 Hz ± 3 %		Permissible combined voltage & frequency variation	± 6 %	System design faults level (Symmetrical)	10 kA for 1 sec. max.	System earthing LV side neutral solidly		Wiring 3 phase, 4 wire on 415V system	
Electrical system data:																								
Power supply for Equipment																								
Voltage 415 V ± 5 %		Frequency 50 Hz ± 3 %																						
Permissible combined voltage & frequency variation	± 6 %	System design faults level (Symmetrical)	10 kA for 1 sec. max.																					
System earthing LV side neutral solidly		Wiring 3 phase, 4 wire on 415V system																						

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

	earthed	
	<b>Auxiliary power supply :</b>	
	<b>Power supply</b>	-----
	<b>Control Supply</b>	-----
	<b>Space heater power supply</b>	-----
	<b>Illumination power supply</b>	-----
	<b>Plug-socket power supply</b>	-----
<b>4.0</b>	<b><u>TECHNICAL REQUIREMENTS</u></b>	
<b>4.1</b>	<b><u>SYSTEM</u></b>	
	The lighting distribution boards shall be suitable for operation on 415/240 volt, 50 cycle per second, and A.C supply system. The lighting & power distribution boards MCB shall be capable of withstanding short circuit current of 10 KA.	
<b>4.2</b>	<b><u>CONSTRUCTION</u></b>	
	The DB's shall be factory made and of those and as per the G.A. layout enclosed. General arrangement lay out of the DB's shall be approved by the consultants in charge before starting the manufacture.	
	The DB shall metal clad duly fabricated from 2mm. thick high quality CRCA sheet metal.	
	The DB shall be wall mounted and dead front operated.	
	The DB shall totally be enclosed and made dust, vermin and weather proof such that it meets to IP42 protection classification for installation.	
	<p>A detachable cover plate of 2 mm thick CRCA sheet to be provided on front of the board such that all live parts of the electrical accessories mounted on the board can be accessible only on removal of the said cover plate.</p> <ol style="list-style-type: none"> <li>1) The cover plate shall be fixed to the board with adequate size zinc passivized machine screws.</li> <li>2) Above the detachable cover plate, one additional hinged door of 2 mm thick CRCA sheet shall be provided with a suitable locking arrangement.</li> </ol> <p>The hinged door shall be provided with a suitable gasket capable of withstanding corrosive &amp; humid atmosphere and to maintain degree of enclosure protection to IP 42 as per IS: 13947 for installation.</p>	
	The DB shall have top/Bottom entry arrangement for incoming and outgoing cables/conduits.	
	All hardware to be used in manufacture of the DB shall be S.S 304 to prevent corrosion due to	

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	humid atmosphere prevailing at the project site.
	All internal electrical connections shall be carried out using 660/1100 volt grade, FRLS insulated, Copper conductor of ISI approved make, having rated current carrying capacity to carry continuous full current of respective switch Fuse rating at operating conditions prevailing at the project site.
	The DB internals shall be earthed with use of Copper wires/strips running throughout the length. Size of the earthing strip/wire shall be as shown in the respective drawing.
	All non-current carrying metal surface of the DB's shall adequately be treated and painted.
	The surface imperfection shall then be rectified with applications of putty.
	The DB's shall be provided with electric components and accessories as per the details shown in the drawing for the respective electric distribution board. The circuit connection from all the circuit MCB shall be brought to connector provided on top or bottom of the DB with suitable lugs. The connector shall be suitable to receive phase, neutral and earth wire/cable coming from each individual circuit. The connector's shall have circuit identification tag.
	Use of paper/fabric base laminates is not acceptable.
<b>4.3</b>	<b><u>PAINTING</u></b>
	The painting shall be as per "PAINTING" specification only.
<b>5.0</b>	<b><u>DRAWING &amp; INFORMATION</u></b>
	The following drawings shall be submitted along with the bid:
	General arrangement drawing showing overall dimensions, weight, internal arrangement and mounting details.
	Terminal chamber, showing bus-bar arrangement with all dimensions.
	Power wiring diagram
<b>6.0</b>	<b><u>METHOD OF MEASUREMENT</u></b>
<b>6.1</b>	Supply of the Lighting DB including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.
<b>7.0</b>	<b><u>TRANSPORT, DELIVERY &amp; STORAGE</u></b>
	The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of Lighting DB on site store. The Lighting DB should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site

<p align="center"><u>TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS</u></p>
--

	should form part of offer.
<b>8.0</b>	<b><u>GUARANTEE &amp; WARRENTY</u></b>
	The quotes values of parameters shall be within given tolerance for given period of service life.
<b>9.0</b>	<b><u>SPARES</u></b>
	The bidder shall quote for minimum spares required for two years safe operation of Distribution Board along with the offer separately
<b>10.0</b>	<b><u>ATTACHMENTS</u></b>
	BOQ for LDB and PDB
<b>11.0</b>	<p>:-Electrical contractor to survey the site and check all wiring/conduit /mains/s.b./DB.</p> <p>:-Any discrepancy/extra item to be brought in discussion and to submit in written all backup data as support to PIU authority before executing any works related to wiring.</p>



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

4.0	TECHNICAL SPECIFICATIONS FOR SUPPLY OF LIGHT FIXTURE																												
1.0	<u>SCOPE OF WORK</u>																												
	<p>The scope of work shall cover the supply, installation and testing of various types of light fixtures. The fixture shall comply following general criteria</p> <ul style="list-style-type: none"><li>• The manufacturer should have one single order for Indoor Commercial Luminaires for atleast 3 Cr.</li><li>• The manufacturer should have executed one single order from Government /semigovernment/ Central Govt authorities for atleast 6 Cr capacity during the last 3 Years . Order copies should be produced.</li><li>• The manufacture should provided Complete TTC and quality assurance Plan for Fixtures during supply.</li><li>• The Warranty letter for 5years should be provided by the Manufacturer.</li></ul>																												
2.0	<u>CODES &amp; STANDARDS</u>																												
	<p>The following standards and rules shall be applicable :</p> <table><tr><td>IS 3646 (1960)</td><td>Code of practice for interior illuminator.</td></tr><tr><td>IS 1913(1969)</td><td>General and Safety requirements for electric lighting fittings.</td></tr><tr><td>Indian Electricity Act and Rules issued here under.</td><td></td></tr></table>				IS 3646 (1960)	Code of practice for interior illuminator.	IS 1913(1969)	General and Safety requirements for electric lighting fittings.	Indian Electricity Act and Rules issued here under.																				
IS 3646 (1960)	Code of practice for interior illuminator.																												
IS 1913(1969)	General and Safety requirements for electric lighting fittings.																												
Indian Electricity Act and Rules issued here under.																													
3.0	<u>DESIGN BASIS &amp; SITE CONDITIONS</u>																												
	<table><tr><td colspan="4">Electrical system data:</td><td></td></tr><tr><td colspan="4">Power supply for Equipment</td><td></td></tr><tr><td colspan="2">Voltage    415 V ± 5 %</td><td colspan="2">Frequency 50 Hz ± 3 %</td><td></td></tr><tr><td>Permissible combined voltage &amp; frequency variation</td><td>± 6 %</td><td>System design faults level (Symmetrical)</td><td>35 kA for 1 sec. max.</td><td></td></tr><tr><td colspan="2">System earthing LV side neutral solidly earthed</td><td colspan="2">Wiring 3 phase, 4 wire on 415V system</td><td></td></tr></table>				Electrical system data:					Power supply for Equipment					Voltage    415 V ± 5 %		Frequency 50 Hz ± 3 %			Permissible combined voltage & frequency variation	± 6 %	System design faults level (Symmetrical)	35 kA for 1 sec. max.		System earthing LV side neutral solidly earthed		Wiring 3 phase, 4 wire on 415V system		
Electrical system data:																													
Power supply for Equipment																													
Voltage    415 V ± 5 %		Frequency 50 Hz ± 3 %																											
Permissible combined voltage & frequency variation	± 6 %	System design faults level (Symmetrical)	35 kA for 1 sec. max.																										
System earthing LV side neutral solidly earthed		Wiring 3 phase, 4 wire on 415V system																											
4.0	<u>TECHNICAL REQUIREMENTS</u>																												

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>4.1</b>	<b>GENERAL REQUIREMENTS</b>
	All fixtures shall be complete with accessories and fixings necessary for installation whether so detailed under fixture description or not
	Fixture housing, frame or canopy shall provide a suitable cover for the fixture outlet box of fixture opening
	Fixture shall be installed at mounting heights as detailed on the drawings or instructed on site by the client's representative
	Fixtures and/or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the fixture. Design of hangers and method of fastening other than shown on the drawings or herein specified shall be submitted to the client's representative for approval
	Fixture shall be completely wired and constructed to comply with the regulations and standards for Electric Lighting Fixtures, unless otherwise specified. Fixtures shall bear manufacturer's name and the factory inspection label unless otherwise approved
	Wiring within the fixture and for connection to the branch circuit wiring shall be not less than 1.5 sq.mm. copper for 250 Volt application. Wire insulation shall suit the temperature conditions inside the fixture and wires bypassing the choke shall be heat protected with a heat resistant sleeve
	Metal used in lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specifications or standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burrs and tool marks. Solder shall not be used as mechanical fastening device on any parts of the fixture
	Ferrous metal shall be bonderized and given a corrosion resistant phosphate treatment or other approved rust inhibiting prim coat to provide a rust-proof base before application of finish
	Non-reflecting surfaces such as fixture frames and trim shall be Alluminium die cast
	All the fixtures are as per the IP - 54 insulation class
	Vendor shall be responsible for measuring the level of illumination after installation
	Lighting fixtures shall be designed for minimum glare and for continuous operation under specified atmospheric condition
	All fixtures shall be complete with accessories like power factor improvement capacitors, ballast, ignitor etc
	Fluorescent fixture shall be of sheet steel casing with corrosion resistance finish. It shall be provided with separate wiring channel with cover plate and an earth terminal. All screw shall be chromium brass only. Lamp and starter holders shall be of tough molded plastic with spring loaded rotor type connector. Condensers shall be low loss paper impregnated hermetically sealed. Internal wiring shall be neatly clipped and where by passing the ballast, a suitable heat resistance barrier or sleeve shallbe provided.
<b>4.2</b>	<b>REFLECTOR</b>

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

	Light reflecting surface shall be mirror finished having the reflection factor of not less than 80%. All parts of reflector shall be completely covered by finish and free from irregularities. It shall be capable of withstanding a 6 mm. radius bend without showing sign of cracking, peeling or loosening from the base metal. Finish shall be capable of withstanding 72 hours exposure to ultra violet sun lamp placed 10 cm. from the surface without discoloration, hardening or warping and retain the same reflection factor after exposure. Test result shall be furnished for each lot of fixtures
	Lighting fixture reflectors shall generally be manufactured from sheet steel or aluminium of not less than 20 SWG. They shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools. They shall be securely mounted to the housing by means of positive fastening devices of a captive type.
	Polystyrene egg-box type louvers shall be provided whenever specified. Appropriate captive type fixing devices shall be incorporated for securing these.
<b>4.3</b>	<b>BALLAST</b>
	Lighting fixtures ballasts shall be designed, manufactured and supplied in accordance with the relevant standard IS 6616 and shall function satisfactorily under site conditions specified. The ballasts shall have a long service life and low power loss
	Ballasts shall be mounted using self-licking, anti-vibration fixings and shall be easy to remove without removing the fittings
	Ballast shall contain a thermosetting type compound not subject to softening or liquefying under any operating conditions or upon ballast failure. The ballasts shall be of the inductive and heavy duty type. Filled with polyester or equivalent. They shall be free from hum and protected from the atmosphere. Ballasts which produce a humming sound shall be replaced free of cost by the supplier. HPMV lamp ballasts shall be provided with suitable tapplings
<b>4.4</b>	<b>STARTERS</b>
	Lighting fixtures starters shall be of the safety type (i.e. if the lamp fails to ignite at the first start, no further starting must be possible without attending to the tube light. Starters shall have bimetal electrodes and high mechanical strength
	Starters shall be replaceable without disturbing the reflector or lamps and without the use of any tool. Starters shall have brass contacts and radio interference capacitor
<b>4.5</b>	<b>CAPACITORS</b>
	Lighting fixture capacitors shall have a constant value of capacitors and shall be connected across the supply of individual lamp circuits
	Each capacitor shall be suitable for operation at 240 volts $\pm$ 5% single phase 50 Hz with a suitable value of capacitance so as to correct the power factor of the corresponding lamp circuit to the extent of 0.98 lag
	The capacitors shall be hermetically sealed preferably in metal container to prevent seepage of impregnating material and ingress of moisture

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>4.6</b>	<b>LAMP HOLDER</b>
	Lamp holders for fluorescent tubes shall be of the spring loaded, low contact resistance, bi-pin rotor type, resistant to wear and suitable for operation at the specified temperature, without deterioration in insulation value, contact resistance of lamp holding quality. The shall hold the lamp in position under normal condition of shock and vibration
	Lamp-holders for incandescent and HPSV lamps shall be of G.L.S. type manufactured in accordance with relevant standards and designed to give long and satisfactory service
<b>4.7</b>	<b>LUMINAIRES</b>
	HPSV fixture shall be of single die cast aluminium made out of LM6 canopy , anodized high purity aluminium reflector, toughened glass at the front and die cast aluminium control gear box complete with all accessories mention in 3.22 with pre-wired up to connector block and loop in and loop out facilities
	Street light fixture shall be of single die cast aluminium housing with provision for the easy removal of gear box during maintenance. Acrylic bowl shall be linked to one end and toggle shall be provided. Neoprene rubber and felt gasket shall be provided between acrylic bowl and fixture to prevent entry of insects and moisture
	Industrial low bay fitting shall be of die cast aluminium housing, high purity Al. Reflector, acrylic cover and wire guard
<b>4.8</b>	<b>LAMPS</b>
	Lamps shall be supplied and installed in all lighting fixtures furnished under this contract
	Lamps used for temporary lighting service shall not be used in the final lamping of fixture units
	Lamps shall be of wattage and type as shown on the drawings and schedules. Where not shown, the details shall be ascertained from the client before procurement
	Lamps for permanent installation shall not be placed in the fixtures until so directed by the Client's representative, and this shall be accomplished directly before the respective portions are ready for occupation
<b>5.0</b>	<b><u>DRAWINGS &amp; INFORMATION</u></b>
	As per of the proposal the bidder furnish relevant descriptive and illustrative literature on lighting fixtures and accessories and following drawings/ data for the respective lighting fixtures:- <ol style="list-style-type: none"> <li>1. Dimensional Drawings.</li> <li>2. Mounting details cable entry facilities and weights.</li> <li>3. Light distribution diagrams (Zonal &amp; Isokandora)</li> <li>4. Light absorption and utilization factors.</li> <li>5. Lamp output V/S temp. curves.</li> </ol>
<b>6.0</b>	<b><u>INSPECTION AND TESTING</u></b>
	Each fixture shall be tested at 1500 volts rms. 50 Hz for one minute and no flashover or breakdown

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	shall occur between current carrying parts and ground
	Insulation resistance of each fixture shall be tested at 500 V.D.C. and the insulation resistances so measured shall not be less than 2 mega ohms between all current carrying parts and ground.
	Each fixture complete with its proper lamp/lamps shall be shown to operate satisfactorily at its normal voltage and frequency
	Each fixture shall be examined visually to ensure that it is complete in all respects and satisfactorily finished
	Type and routine test certificates shall be submitted for tests conducted as per relevant IS/BS for the fixture and accessories
<b>7.0</b>	<b><u>METHOD OF MEASUREMENT</u></b>
	Supply of the fixture including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.
<b>8.0</b>	<b><u>TRANSPORT, DELIVERY AND STORAGE</u></b>
	The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of fixture or site store. The fixture should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.
<b>9.0</b>	<b><u>GUARANTEE AND WARRENTY</u></b>
	The Bidder shall stand guarantee for the performance of entire fixtures and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply. The Purchaser also reserves the right to use the rejected equipment or part thereof until the new equipment meeting the guaranteed performance is supplied by the Bidder.
<b>10.0</b>	<b><u>SPARES</u></b>
	The bidder shall quote for minimum spares required for two years safe operation of light fixtures along with the offer separately.
<b>11.0</b>	<b><u>LED LIGHT FIXTURES</u></b>
	<b><u>GENERAL REQUIREMENT</u></b>
	General Purpose Led Luminaires suitable for Office /Industry / Street Light applications. The Fixtures should be Operational for 220-240 V Single Phase 50 HZ AC , and operational from 170-280 V without significant drop in output .

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<b><u>LED ORIGIN &amp; DRIVER</u></b>
	The LED modules should be from Cree/Nichia/Philips Lumi Leds Only with efficiency of a min 130 lm/watt and efficacy of fixtures should be greater than 80 lm/w for both indoor and outdoor fixtures, built with Integral driver. The class and LED shall be procured from a single bin of class 1 to 2 only. The manufacturer should have its own NABL accredited lab. External Silicon Potted driver forensuring better reliability and safety ( Normal Circuit driver not acceptable without potting )
	<b><u>IP Protection</u></b>
	The Min degree of Protection for Indoor Fixtures should be IP20 and IP65 for Outdoor/ Semi Indoor Fixtures. The THD of Fixtures should be strictly <10 % and drivers should be compulsarily provided with miswiring/ overload and short circuit protections
	<b><u>Housing</u></b>
	For Indoor applications the housing should be made of die cast/ Metal Housing and diffusers should be polycarbonate only, outdoor fixtures should be with die cast aluminum / extruded aluminum housing only.
	<b><u>Fixtures</u></b>
	<p>The Fixtures should be prewired upto the terminal block and easy to mount and Install and maintain if necessary. The fixture should comply LM79-08 certification criteria and also module should be backed with LM80-08 Certificate from the OEM.</p> <p><b>Fixture should be warranted for 5yrs for 50,000 hrs @ L70 ( LM79 from NABL accredited Lab to be submitted along with Letter from Manufacturer for the Life class claim of L70 @ 50,000 hrs.)</b></p> <p>Fixtures shall have PF &gt;=0.9 and THD &lt;=15 % or minimum. Fixture should be manufactured in India (except procurement of LED)</p> <p>The manufacturer should be ISO 9001 -2008 and ISO 14001 -2004.</p> <p>PC Injection Moulded Diffuser for high light transmittivity . (Acrylic / any other material not acceptable )</p> <p>Min IP 20 Ingress Protection for Fixture and driver.</p>
	<b><u>Guarantee, Warranty &amp; Reports</u></b>
	<b>The fixtures should be warranted for a period of 5yrs</b> from the date of Installation. The fixtures should have some kind of embossing/ engraving to identify the brand name
	The manufactures should provide all kind of test report , technical details as and when called for . The fixture may be tested from govt approved Lab for Claimed parameters by the manufacturer.

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>5.0</b>	<b><u>TECHNICAL SPECIFICATIONS FOR SUPPLY OF EARTHING SYSTEM</u></b>				
<b>1.0</b>	<b><u>SCOPE OF WORK</u></b>				
	Design, assembling, testing, painting, supply, delivery at site with all related accessories as per the specifications as specified below. Compliance with the provisions of this specification shall not relieve the Bidder of the responsibility of furnishing apparatus and accessories of proper design, electrically and mechanically suited to meet the operating requirements under the specified service conditions and be suitable for the purpose of which they are intended.				
<b>2.0</b>	<b><u>CODES &amp; STANDARDS</u></b>				
	The design, material, assembling, inspection and testing shall comply with all currently applicable statutes, regulations and safety codes in the locality where the system will be installed. The equipment shall also conform to the latest applicable standards and codes of practice as mentioned below.				
		<b>Sr.</b>	<b>Item</b>	<b>Relevant IS</b>	
		<b>1</b>	Code of Practice for Earthing	IS 3043	
		<b>2</b>	Insulation Co-ordination Application Guide	IS 3716	
		<b>3</b>	Code of Practice for Protection of Buildings and Allied Structures against Lightning	IS 2309	
		<b>4</b>	Indian Electricity Rules, 1956		
		<b>5</b>	Indian Electricity Act, 1910		
		<b>6</b>	National Electrical Code		
<b>3.0</b>	<b><u>DESIGN BASIS &amp; SITE CONDITIONS</u></b>				
	All the equipment and components provided in the system and accessories shall be suitably designed for installation and satisfactory operation as specified below.				
		Electrical system data:			
		Power supply for Equipment			
		Voltage 415V $\pm$ 5 %		Frequency 50 Hz $\pm$ 3 %	
		Permissible combined voltage & frequency variation	$\pm$ 6 %	System design faults level (Symmetrical)	35kA for 1 sec. max.

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

		Wiring 3 phase, 4 wire on 415V system				
4.0	<b><u>TECHNICAL REQUIREMENTS</u></b>					
	The earth grid shall consist of main grounding grid conductors forming a closed ring network with required number of pipe/plate type earthing stations connected to it to provide a common earth for electrical equipments and metallic structures. Two distinct connections shall be made from each earthing station to the main grounding/earthing mat through GI/Cu. flat.					
	The earth bus in required numbers shall be installed in various plant open areas and rooms. Each earth bus shall be provided two distinct connections by GI flats from the main grounding grid conductors available nearby. The plant equipment, metallic structures, tanks, etc. shall be brought to earth by providing two distinct connections between earth bus installed nearby and that equipments, tank, apparatus, etc.					
4.3	<b><u>GENERAL CONSTRUCTIONAL DETAILS</u></b>					
	<b><u>Plate Earthing Stations</u></b>  The plate electrode shall be 600 x 600 x 3.25 mm copper plate or 600 x 600 x 6.15 mm hot dip GI.  <ol style="list-style-type: none"><li>1. The earth resistance shall be maintained with suitable soil treatment</li><li>2. The earth lead shall be connected to the earth plate through Hot Dip G.I. bolts</li><li>3. The earthing conductors shall be of copper strip in case of copper earthing</li><li>4. G.I. pipe with funnel of approved quality shall be used for watering the earthing electrodes / stations.</li><li>5. This brick chamber with cement plaster of dimensions in accordance with the drawing shall be constructed so as to protect the earthing station and to facilitate to locate the earthing station easily. The chamber shall also facilitate pouring of water and would provide easy access for testing, which would require disconnection of the earth electrode and connection to the earthing grid.</li><li>6. IS marked cast iron cover of appropriate dimensions shall be supplied as specified in IS: 3043 along with fabricated MS angle frame. The cover shall be hinged to the frame. The frame shall be grouted in brick masonry work of earthing station. The cove rand frame shall be painted with bitumen paint after applying primer. Earthing station Tag No. shall be painted on top of cover as per designation given on the layout drawing.</li><li>7. The hardware and other consumables for earthing installation shall be of copper/bras in case of copper earth plate and shall be hot dip galvanised iron material in case of G.I. earth plate</li><li>8. The depth of an earth electrode pipe shall be in approximately in accordance with the drawing as well as on nature of soil. However as per general guidelines, the pipe electrode shall have to be placed at depth where soft earth is available. This is to reduce the effect of earth resistance.</li></ol>					
	<b><u>Pipe Electrode Earth Station</u></b>					



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<ol style="list-style-type: none"> <li>1. The earth station shall be as shown on the drawing and shall be used for equipment earth grid and/or street light pole earthing</li> <li>2. The earth electrode shall be 3 M long 38/50 mm diameter class "A", Galvanized steel pipe</li> <li>3. The earth resistance shall be maintained with a suitable soil treatment.</li> <li>4. The earth lead shall be fixed to the pipe with a nut and safety set screws. The clamp shall be permanently accessible</li> <li>5. The earthing grid and the earthing conductor shall be hot dip Galvanized iron strips of the size as shown in the drawing</li> <li>6. G.I. pipe with funnel of approved quality shall be used for watering the earth electrode \ station</li> <li>7. This brick chamber with cement plaster of dimensions in accordance with the drawing shall be constructed so as to protect the earthing station and to facilitate to locate the earthing station easily. The chamber shall also facilitate pouring of water and would provide easy access for testing, which would require disconnection of the earth electrode and connection to the earthing grid.</li> <li>8. The hardware and other consumables for earthing installation shall be of copper/bras in case of copper earth plate and shall be hot dip galvanised iron material in case of G.I. earth plate</li> <li>9. The depth of an earth electrode pipe shall be in approximately in accordance with the drawing as well as on nature of soil. However as per general guidelines, the pipe electrode shall have to be placed at depth where soft earth is available. This is to reduce the effect of earth resistance.</li> </ol>
<b>4.4</b>	<p><b><u>EQUIPMENT EARTHING</u></b></p> <p>All apparatus and equipment transmitting or utilizing power shall be earthed in the following manner. Copper /G.I. Earth strips/wires shall be used unless other-wise indicated.</p>
<b>4.5</b>	<p><b><u>ELECTRICAL AND PERFORMANCE REQUIREMENTS</u></b></p>
	<p><b><u>Power Transmission Apparatus</u></b></p> <ol style="list-style-type: none"> <li>1. Metallic conduit shall not be accepted as an earth continuity conductor. A separate insulated continuity conductor of size 100% of the phase conductor subject to the minimum shall be provided.</li> <li>2. Non metallic conduit shall have an insulated earth continuity conductor of the same size for metallic conduit. All metal junction and switch boxes shall have an inside earth stud to which the earth conductor shall be connected. The earth conductor shall be distinctly coloured (Green or Green / Yellow ) for easy identification</li> <li>3. Armoured cable shall be earthed by two distinct earth connections to the armouring at both the ends and the size of connection being as for the metallic conduit.</li> <li>4. In the case of unarmoured cable, an earth continuity conductor shall either be run outside along with the cable or should form a separate insulated core of the cable</li> <li>5. Three phase power panel and distribution boards shall have two distinct earth connections of the size correlated to the incoming cable size. In case of single phase DB's a single earth connection is adequate</li> </ol>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>5.0</b>	<b><u>DRAWINGS &amp; INFORMATION</u></b>
	Drawing for Plate Type Earthing Station – Annexure-1
	Drawing for Pipe Type Earthing Station – Annexure 2
<b>6.0</b>	<b><u>INSPECTION AND TESTING</u></b>
	The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS: 3043
	<p>The following earth resistance values shall be measured with an approved earth megger and recorded.</p> <ol style="list-style-type: none"> <li>1. Each earthing station</li> <li>2. Earthing system as a whole</li> <li>3. Earth continuity conductors</li> </ol>
	Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 1 ohm in each case.
	Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed
	All tests shall be carried out in presence of the consultant / client
<b>7.0</b>	<b><u>METHOD OF MEASUREMENT</u></b>
	Provision of earthing station complete with excavation, electrode, watering pipe, soil treatment, masonry chamber with cast iron cover etc. shall be treated as one unit of measurement
	<p>The following items of work shall be measured and paid per unit length covering the cost of the earth wires / strips, clamps, labour etc.</p> <ol style="list-style-type: none"> <li>1. Main equipment earthing grid and connection to the earthing station.</li> <li>2. Connection to the switch board, power panels, DB etc</li> </ol>
	<p>The cost of earthing the following items shall become part of the cost of the item itself and no separate payment for earthing shall be made.</p> <ol style="list-style-type: none"> <li>1. Motors - earthing forming part of the cabling / wiring for the motors.</li> <li>2. Isolating switches and starters should form part of mounting frame, switch starter etc.</li> <li>3. Light fittings - form part of installation of the light fittings.</li> <li>4. Conduit wiring, cabling - should form part of the wiring or cabling.</li> <li>5. Street lighting - should form part of the street light poles</li> </ol>
<b>8.0</b>	<b><u>TRANSPORT, DELIVERY AND STORAGE</u></b>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of earthing system or site store. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.
<b>9.0</b>	<b><u>GUARANTEE &amp; WARRENTY</u></b>
	The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply.
<b>10.0</b>	<b><u>SPARES</u></b>
	Not applicable
<b>11.0</b>	<b><u>MATERIALS REQUIRED</u></b>
	All required hardware such as bolts, nuts, washers (round and spring type), anchor fasteners, screws, etc. of sizes and type as required shall be conforming to relevant IS. All hardware shall be hot-dip galvanized or zinc passivated /cadmium plated as per requirement of work either mechanical fabrication or electrical jointing.
<b>11.2</b>	All other items required for installation shall be as approved by site in-charge.
<b>12.0</b>	<b><u>INSTALLATION OF SYSTEM</u></b>
	The plate/pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case less than 3 M below finished ground level
	The plate/pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall / column
	The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture
	20 mm. dia. G.I. pipe for watering, shall run from top edge of the plate / pipe electrode to the mid level of block masonry chamber
	Top of the pipe shall be provided with G.I. funnel and screen for watering the earth / ground through the pipe
	The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber as shown in the drawing
	The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS: 3043, Code of Practice for Earthing Installation.
	The earth conductors ( Strips / Wires, Hot dip G.I. / copper ) inside the building shall properly be clamped / supported on the wall with Galvanized Iron clamps and Hot Dip GI screws / bolts. The conductors outside the building shall be laid at least 600 mm. below the finished ground level/
	The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished
	Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long and bitumen coated.
	The earth conductors shall be in one length between the earthing grid and the equipment to be earthed
	Minimum distance of 2 mtr shall be maintained between other electric conductor, earthing conductor and the conductor laid for the lightning protection system. Earthing and lightning protection system conductors shall be bonded to each other to prevent side flashover in case of non-availability of adequate clearance.
	The earthing met conductors, risers, earthing cables, etc. passing through walls shall be covered with galvanized iron sleeves for the passage through wall. Water stop sleeves shall also be provided wherever the earthing conductor enters the building from outside.

6.0	TECHNICAL SPECIFICATIONS FOR SUPPLY OF LIGHTNING PROTECTION.																									
1.0	SCOPE																									
	Supply, installation, connection, testing and commissioning of lightning protection system of the following:  1. Air termination network  2. Roof conductors  3. Down conductors  4. Testing joint  5. Earth termination network																									
2.0	CODES & STANDARDS																									
	The lightning protection system shall comply with Indian Code of Practice 2309: 1989 and Indian Electricity Acts and Rules.																									
3.0	DESIGN BASIS & SITE CONDITIONS																									
	All the equipment and components provided in the Lightning Protection System and accessories shall be suitably designed for installation and satisfactory operation as specified below. <table><tr><td colspan="2">Site conditions</td></tr><tr><td>Location – RAJPIPLA MEDICAL CAMPUS</td><td>Site altitude 50 M above mean sea level</td></tr><tr><td>Ambient temperature</td><td>Relative humidity</td></tr><tr><td>Maximum 47 °C</td><td>Maximum 98 %</td></tr><tr><td>Minimum 05 °C</td><td>Minimum 40 %</td></tr><tr><td>Design 45 °C</td><td>Design 98 % at 50 °C</td></tr><tr><td>Seismic factor Zone III as per IS:1893</td><td>Rainfall 1000 mm/year</td></tr><tr><td>Environmental Tropical/humid/corrosive conditions</td><td>Location of Equipment Outdoor</td></tr><tr><td>Wind speed 80 kmph maximum</td><td></td></tr><tr><td colspan="2">Electrical system data:</td></tr><tr><td colspan="2">System earthing Neutral solidly earthed</td></tr><tr><td colspan="2"></td></tr></table>		Site conditions		Location – RAJPIPLA MEDICAL CAMPUS	Site altitude 50 M above mean sea level	Ambient temperature	Relative humidity	Maximum 47 °C	Maximum 98 %	Minimum 05 °C	Minimum 40 %	Design 45 °C	Design 98 % at 50 °C	Seismic factor Zone III as per IS:1893	Rainfall 1000 mm/year	Environmental Tropical/humid/corrosive conditions	Location of Equipment Outdoor	Wind speed 80 kmph maximum		Electrical system data:		System earthing Neutral solidly earthed			
Site conditions																										
Location – RAJPIPLA MEDICAL CAMPUS	Site altitude 50 M above mean sea level																									
Ambient temperature	Relative humidity																									
Maximum 47 °C	Maximum 98 %																									
Minimum 05 °C	Minimum 40 %																									
Design 45 °C	Design 98 % at 50 °C																									
Seismic factor Zone III as per IS:1893	Rainfall 1000 mm/year																									
Environmental Tropical/humid/corrosive conditions	Location of Equipment Outdoor																									
Wind speed 80 kmph maximum																										
Electrical system data:																										
System earthing Neutral solidly earthed																										

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

4.0	TECHNICAL REQUIREMENTS
	<p>The lightning protection system shall be installed as indicated on the drawings or in case such is not available, the contractor shall prepare one as per Indian CP 2309 and approved by Architect.</p> <p>An air terminal shall be installed on the highest roof of the building. The air terminal shall be joined to horizontal roof conductor by means of rivets/clamps.</p> <p>Roof conductor shall be laid horizontally on the roof as indicated by the design.</p> <p>Down conductor shall be installed on the vertical surface of the building</p> <p>Down conductors shall be joined with roof conductors as prescribed by the Code of Practice. A test joint shall be provided in the down conductor, 100cm. above the ground level at a place that is easily accessible for testing.</p> <p>The down conductor shall be joined to an earth termination network or to the earthing station as indicated by the design.</p> <p>The earthing station and the earthing conductor shall be designed as per section under heading "Earthing".</p>
	<p><b>Pair Terminals and Roof Conductors</b></p> <p>An Air termination shall consist of vertical conductor or a system of horizontal conductors and shall be installed along the outer perimeter of the roof.</p> <p>No part of the roof shall be more than 9 mtr. From the nearest horizontal protective conductor.</p> <p>All metallic projections, chimneys, ducts, vent pipe, railings, gutters etc. on or above the main surface of the roof of the structure shall be bonded to the firm part of the Air termination network. The method and nature of fixing shall be simple, solid and permanent.</p> <p>The minimum dimension of the Air termination network shall be G.I.: 25 x 3 mm</p> <p>The Pair terminal shall be installed vertically on the highest point of the roof and shall be clamped firmly with the structure. The roof conductor shall be laid horizontally below the finishing of the roof surface.</p>
	<p>The no. of down conductors shall be as follows :</p> <ol style="list-style-type: none"> <li>1. A structure having a base area not exceeding 100 sq.mtr. shall have only one down conductor</li> <li>2. For a structure having a base area exceeding 100 sq.mtr., the no. of down conductors shall equal to smaller of the following:</li> <li>3. One plus one for every 300 sq.mtr. or part thereof in excess of the first 100 sq.mtr. <b>OR One</b> for every 30mtr. per perimeter.</li> </ol> <p>The down conductor shall be distributed round the outside wall of the structure.</p> <p>Any external metal running vertically through the structure shall be bonded to the down conductor at the top and bottom.</p> <p>A down conductor shall follow the most direct path possible between the air terminals and the earth termination.</p> <p>The size of the down conductor shall be similar to roof conductor or air termination network.</p>

	<p>Each down conductor shall be provided with a testing joint in such a position that, it is convenient for testing</p> <p><b>Joints and Bonds :</b></p> <p>The lightning protection system shall have as few joints as possible. Joints and bonds shall be mechanically and electrically effective, eg. clamped, screwed, bolted, riveted or welded. With over looping joint the length of over looping shall not be less than 25 mm. for all types of conductor. Contact surfaces shall be first cleaned then inhibited from oxidation with a suitable non-corrosive compound.</p>																								
	<p><b>EARTH RESISTANCE :</b></p> <p>The resistance from any part of the lightning protection system to earth shall not exceed 1 ohm before any bonding has been effected to metal in or on a structure or to services below ground. If the value obtained exceeds the specified one then shall be reduced by adding to the number of earth electrode.</p>																								
	<p><b>General</b></p> <p>Lightning Protection System shall be in accordance with IEC 62305-3, IS/IEC - 62305 and NBC DEC-2016.</p> <p><b>Zone of Protection</b></p> <p>The zone of protection of a lightning conductor defines the space within which Air Terminal provides protection against a direct lightning strike with probability of protection as per LPL.</p> <p><b>LPL (Lightning Protection Level)</b></p> <p>LPL is a number associated with a set of lightning current parameters relevant to the probability that the associated minimum &amp; maximum values do not exceed the normally occurring lightning. LPL can be determined by Risk analysis as explained in IEC 62305-2 .</p> <p><b>LPL levels and probability of protection:</b></p> <table><tr><th>Lightning protection</th><th>Lightning current</th><th>Lightning current</th><th>Interception</th></tr><tr><td>Class</td><td>peak value MINIMUM</td><td>peak value MAXIMUM</td><td>probability</td></tr><tr><td>LPL 1</td><td>3 kA</td><td>200 kA</td><td>98%</td></tr><tr><td>LPL 2</td><td>5 kA</td><td>150 kA</td><td>95%</td></tr><tr><td>LPL 3:</td><td>10 kA</td><td>100 kA</td><td>88%</td></tr><tr><td>LPL 4</td><td>16 kA</td><td>100 kA</td><td>78%</td></tr></table>	Lightning protection	Lightning current	Lightning current	Interception	Class	peak value MINIMUM	peak value MAXIMUM	probability	LPL 1	3 kA	200 kA	98%	LPL 2	5 kA	150 kA	95%	LPL 3:	10 kA	100 kA	88%	LPL 4	16 kA	100 kA	78%
Lightning protection	Lightning current	Lightning current	Interception																						
Class	peak value MINIMUM	peak value MAXIMUM	probability																						
LPL 1	3 kA	200 kA	98%																						
LPL 2	5 kA	150 kA	95%																						
LPL 3:	10 kA	100 kA	88%																						
LPL 4	16 kA	100 kA	78%																						

**Components of External LPS**

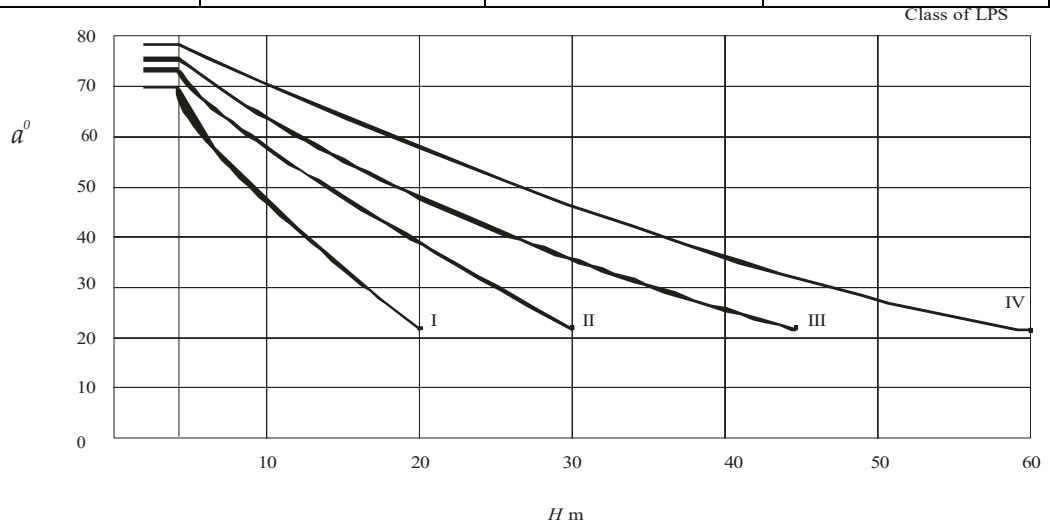
- 1.) Air terminal (as per rolling sphere or mesh or protective angle method or any combination thereof)
- 2.) Down conductor
- 3.) Earthing

**1) Air termination system:**

No drilling or welding is allowed in the terrace for fixing the air terminal.

**Values of Rolling sphere radius, Mesh size and protection angle as per Class of LPL/LPS.**

Class of LPL/LPS	Rolling sphere radius(m)	Mesh size (m)	Protection angle
1	20	5*5	Refer figure 1
2	30	10*10	Refer figure 1
3	45	15*15	Refer figure 1
4	60	20*20	Refer figure 1



If the structure height is more than 60 meters, top 20% of the height of the structure shall be protected with a lateral air termination system. This is needed because, the probability of flashes to the side is generally more for structures more than 60 meters in height. For structures of height more than 120 meters, ring has to be formed for every 20 meters height of the building above 60 meters height.

**Material and Dimensions**

Material of air terminal, down conductor, earth termination etc. shall be as below:

Material	May be destroyed by galvanic coupling with
----------	--



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

Copper(Solid)	GI and Aluminium
Hot galvanized steel(Solid)	Copper
Stainless steel(Solid)	.....
Aluminium(Solid)	Copper

Dissimilar metals (For eg copper with Aluminium) must be connected only by using bime connectors.

### Min Thickness of metal in air termination system for LPL /LPS -3

Material	Thickness (a) in mm	Thickness (b) in mm
Galvanized steel	4	0.5
Stainless steel	4	0.5
Copper	5	0.5
Aluminium	7	0.65

(a) Prevents puncture, hot spot or ignition

(b) Allowed only if **it is not important to prevent** puncture, hotspot or ignition

### **Material configuration and Min cross sectional area of air terminal and down conductors**

Material	Type	Min cross section ar	Remarks
Copper	Solid tape	50 sq mm	2mm min thickness
Copper	Solid round	50 sq mm	8mm dia
Aluminum	Solid tape	70 sq mm	3 mm min thickness
Aluminium	Solid round	50 sq mm	8 mm dia
GI	Solid tape	50 sq mm	2.5 mm min thickness
Stainless steel	Solid tape	50 sq mm	2 mm min thickness

### **Air terminal holder**

Conductors shall be securely fixed on the terrace by means of air terminal holder which is fixed on the roof by adhesive of good quality taking care of varying weather conditions. Air conductor holder is an insulator & should be of minimum 50 mm height so that even small amount of water logging on terrace is below the level of conductor holder. Air terminal holder shall not be more than 0.5 m apart for a flat conductor & 1m for round conductor of atleast 8mm diameter & 1.0 meter apart for vertical run.

### **Recommended distance between air terminal holders.**

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

Arrangement	Recommended distance for SOLID TAPE	Recommended distance for ROUND conductors
Horizontal conductor on horizontal surface.	500 mm	1000 mm
Horizontal conductor on vertical surface	500 mm	1000 mm
Vertical conductor from Ground to 20m height	1000 mm	1000 mm
Vertical conductor above 20m height	500 mm	1000 mm

If antenna, air cooler or any other electrical equipment is present above terrace level, the same have to be protected by using vertical air terminal after calculating the safety or separation distance. The vertical air terminal has to have suitable supports to hold it. Vertical air terminal must be connected to horizontal air terminal by using suitable connectors.

At the crossings of the horizontal air terminals, suitable T or Cross connector has to be used for secure connection.

**Safety or Separation distance.**

It is must to calculate safety or separation distance in order to avoid flash over to the electrical equipment when the lightning current is passing through the vertical air terminal.

**Safety/Separation distance (S) in m = (  $k_i * k_c * L$  ) / km**

Coefficient  $k_i$  depends on class of LPL/LPS.

$k_i = 0.08$  for LPL1,

$k_i = 0.06$  for LPL 2,

$k_i = 0.04$  for LPL3 and 4.

Coefficient  $k_c$  depends on no of down conductors:

$k_c = 0.66$  for 2 down conductors

$k_c = 0.44$  for 3 or more down conductors

Value of coefficient  $k_m = 1$

Value of L is the total distance between the equipment to be protected ( for e.g. Antenna) to the equi-potential bonding bar situated just above the ground.

### **Need for Expansion piece**

In order to take care the expansion of the metal in summer and contraction of the metal in winter, expansion piece with suitable connectors have to be used at every 20m distance of horizontal air terminal.

### **Joints and Bonds**

The lightning protective system shall have as few joints. As far as possible, air terminal & down conductor have to be straight. Where it is not possible, it should NOT be bent at 90 degree (right angles) & should have a curved path of 45 degree..

### **2.) Down conductor system**

In order to reduce the probability of damage to electronic/electrical equipment, the down conductors shall be arranged in such a way that from the point of strike to earth, several parallel current paths should exist & length of the current path should be minimum .Down conductors can be installed separately or more wisely it can be part of natural components of the building Examples are steel reinforcement in RCC columns, metal facades, profile rails, metal doors & windows. Down conductors should be installed at each exposed corner of the structure.

### **Value of distance between down conductors as per Class of LPL / LPS.**

Class of LPL/LPS	Typical distance (m)
1	10
2	10
3	15
4	20

### **Test joints:**

At the connection of the earth terminal, a test joint should be fitted on each down conductor, except in the case of natural down conductors combined with foundation earth electrode. The purpose of test joint is to measure the earth resistance value.

### **Earth Terminations**

Earth mat is most preferable. Where earth mat is not possible, ring earthing is the next best method. Ring earthing must be 1 meter away from the building and 0.5m below the ground level. The resistance of earthing system shall not exceed 10 ohm as per IEC 62305. Lower earth resistance is still better.

	<p>For earth termination system, 2 basic types of earth electrode arrangements are applicable.</p> <p>Type A &amp; Type B arrangement.</p> <p><b>Type A arrangement:</b> comprises of horizontal or vertical earth electrode installed outside the structure to be protected connected to each down conductor. In type A arrangement, the total number of earth electrodes shall not be less than two.</p> <p>Type A arrangement is suitable in places where electronic equipments are not located.</p> <p><b>Type B arrangement:</b> This type of arrangement comprises either a ring conductor external to the structure to be protected, in contact with the soil for atleast 80% of its total length or a foundation earth electrode. Such earth electrodes can also be meshed. For structures with extensive electronic systems or with high risk of fire, type B earthing is most preferable method. Corrosion proofing band has to be used wherever down conductor is connected to earth termination system. Bitumen has to be applied at the point of inter-connection.</p> <p>In potentially corrosive areas, Stainless steel must always be used.</p> <p><b>1.1 References:</b></p> <p><b>1.2 IEC62305 – PROTECTION AGAINST LIGHTNING:</b></p> <p><b>1.3 Part 1: General Principles</b> Part 2: Risk Management Part 3: Protection of structures Part 4: Protection of Electrical &amp; Electronic equipments within structure</p> <p>IS 2309: 1989: Code of practice -Protection of Buildings &amp; allied structures against lightning.</p> <p>IS3043: 1987 : Code of practice for earthing.</p>
	<p><b>DRAWING &amp; INFORMATION</b></p> <p>Drawing as per final execution should be submitted as as-built drawings indicating locations of earthing stations.</p>
	<p><b>INSPECTION &amp; TESTING</b></p> <p>Earth resistance of each earth pit should be measured and recorded.</p>
	<p><b>METHOD OF MEASUREMENT</b></p> <p>The complete earth conductor shall be measured and paid per unit length, including Air termination network, down conductor, test joints and earthing termination network</p>

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS
---

	<p><b>TRANSPORT, DELIVERY &amp; STORAGE</b></p> <p>The prices shall be <b>F.O.R. site basis</b> including packing &amp; forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location or site store. All incidental expenses during transportation shall be part of quoted prices including <b>transit insurance</b>.</p>
	<p><b>GUARANTEE &amp; WARRENTY</b></p> <p>The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier.</p>
	<p><b>SPARES</b></p> <p>Not applicable</p>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>7.0</b>	<b><u>ERECTION, TESTING &amp; COMMISSIONING OF ELECTRICAL INSTALLATIONS</u></b>
<b>1.0</b>	<b><u>SCOPE OF WORK</u></b>
<b>1.1</b>	The intent of this specification is to define the requirements for the installation, testing and commissioning of the electrical system like H.T VCB panel, transformer, L.T. panels, Cables, earthing network, Internal and External lighting, Light fixtures etc.. Requirement of this project shall be as specified in bill of quantities / approved drawings / general specifications or as per the battery limits fixed by the owner / consultant.
<b>2.0</b>	<b><u>STANDARDS</u></b>
<b>2.1</b>	<p>The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specification / codes of practice of the Indian Standards Institution, approved drawings and the instructions issued by the authorised representative, from time to time. Some of the relevant Indian Standards are listed elsewhere in this tender document.</p> <p>In addition to the standards mentioned in 2.1, all works shall also conform to the requirement of the following :</p> <ol style="list-style-type: none"> <li>1. Indian Electricity Act and Rules framed thereunder.</li> <li>2. Fire Insurance Regulations.</li> <li>3. Regulations laid down by the Chief Electrical Inspector of the State / State Electricity Board / Union Territory.</li> <li>4. Regulations laid down by the Factory Inspector of the State / Union Territory.</li> <li>5. Any other regulations laid down by the local authorities.</li> <li>6. Installation &amp; operation manuals of original manufacturers of equipment.</li> </ol>
<b>3.0</b>	<b><u>ERECTION</u></b>
<b>3.1</b>	The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. Equipment shall not be removed from packing cases unless the floor has been made ready for installing them. The cases shall be opened in presence of the client / consultant or his authorised representative. The empty packing cases shall be returned to the stores and any document if found with the equipment shall be handed over to the client's representative. Any damage or shortage noticed shall be reported to the client / consultant in writing immediately after opening of packing cases.
<b>3.2</b>	<p><b><u>DRY TYPE TRANSFORMER</u></b></p> <p><b>1) <u>Erection</u></b></p> <p>Transformer complete miscellaneous accessories shall be thoroughly inspected and any damage noticed shall be reported to the client / consultant. Before erection of transformer, the level of rails on foundation shall be checked and minor corrections if necessary shall be carried out. After the completion of erection, necessary stoppers shall be provided at the wheels. All loosely supplied fittings / accessories shall be cleaned and mounted on the transformer and connections made. After completely assembling &amp;</p>

	<p>installation, the transformer shall be cleaned and touched up with a paint supplied by the manufacturer applied wherever necessary. All cover bolts shall be checked for proper tightness. (The foundation of transformer and rail fixing will be made by some other agency).</p> <p><b>2) Testing</b></p> <ul style="list-style-type: none"> <li>• Winding insulation resistance shall be measured from primary and secondary to ground and between primary and secondary.</li> <li>• Test the operation of thermister type sensor relay in accordance with the manufacturer's instructions.</li> <li>• Check the polarity of terminals and the phase sequence.</li> </ul> <p><b><u>Proforma for transformer tests :</u></b></p> <ul style="list-style-type: none"> <li>• <b>Proforma for transformer tests :</b></li> <li>• Transformer name plate.</li> <li>• Insulation resistance test with 1000 V meagre. <ul style="list-style-type: none"> <li>a) between primary to earth</li> <li>b) between secondary to earth</li> <li>c) between primary and secondary</li> </ul> </li> <li>• Operation of the tap changer (off load tap changer) to be checked</li> <li>• Polarity marking and phase sequence.</li> <li>• Earth resistance:Body &amp; Neutral tank.</li> </ul> <p>[This proforma shall be jointly signed by the CLIENT/ CONSULTANT and the contractor in duplicate]</p>
<p><b>3.3</b></p>	<p><b><u>POWER CONTROL CENTER / MOTOR CONTROL CENTER, DISTRIBUTION BOARDS</u></b></p> <p><b>1.0 Erection</b></p> <ul style="list-style-type: none"> <li>• Electrical panels and bus duct shall be delivered in convenient shipping section by the manufacturer. The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. The contractor shall be responsible for final assembly and interconnection of busbars / wiring. Foundation channel shall be grouted in the flooring by the contractor. Switchgear shall be aligned and levelled on their base channels and bolted to them as per the instructions of the client / consultant. The earth bus shall be made continuous throughout the length. Loosely supplied relays and instruments shall be mounted and connected on the switchgear. The contacts of the drawout circuit breaker shall be checked for proper alignment and interchange ability.</li> <li>• After erection, the switchboard shall be inspected for dust and vermin proof. Any hole which might allow dust or vermin etc. to enter the panel shall be plugged suitably at no extra cost. If the instrument transformers are supplied separately, they shall be erected as per the direction of the client / consultant. The contractor shall fix the cable glands after drilling the bottom / top plates of all</li> </ul>

switchboards with suitable holes at no extra cost.

- Range of overload relays / timers etc. shall be checked with requirement of motor actually to be connected at site and if the same is undersized / oversized, it shall be brought to the notice of the client / consultant, who shall arrange procurement of corrected components. However, the contractor shall not charge anything extra for labour for such replacements.
- The busduct shall be suitably supported between switchgear and transformer. The opening in the wall where the duct enters, the switchgear room shall be sealed to avoid rain water entry. The foundation of the switchgear shall be raised suitably for minor adjustment to ensure proper alignment and connection of the busduct at no extra cost. Expansion joints, flexible connection, etc. supplied by the manufacturer / contractor of the busduct shall be properly connected.

## **2.0 Testing**

- Before electrical panel is energised, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contacts open.
- Before switchgear is energised, the insulation resistance of all control circuits shall be measured from line to ground.
- The following tests shall be performed on all circuit breakers during erection.
- Contact alignment and wipe shall be checked and adjustment where necessary in accordance with the breaker manufacturer's instructions.
- Each circuit breaker shall be drawn out of its cubicles, closed manually and its insulation resistance measured from phase to phase and phase to ground.
- All adjustable direct acting trip devices shall be set using values given by the consultant/ manufacturer.
- The dielectric strength of insulating oil wherever applicable, shall be checked.
- Before switchgear is energised, the following tests shall be performed one each circuit breaker in its test position.
- Close and trip the circuit breaker from its local control switch push button or operating handle. Switchgear control bus may be energised to permit test operation of circuit breaker with A.C. closing with prior permission of the client / consultant.
- Test tripping of the electrically operated circuit breaker by operating mechanical trip device.
- Test proper operation of circuit breakers latch, check carriage limit switch if provided. Test proper operation of lockout device in the closing circuit. Wherever provided by simulating conditions which would cause a lockout to occur.
- Trip breaker either manually or by applying current or voltage to each of its associated protective release.
- Before switchgear is energised, the tests covered above shall be repeated with each breaker in its normal operating position.
- Capacitor banks shall be tested as per manufacturer's instructions. In addition, test for output and/or capacitance, insulation resistance test and test for efficiency of discharge device shall be carried out.
- All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under



	<p>simulated abnormal conditions.</p> <p align="center"><b><u>Performa For PCC, MCC, DB, Control Panel Test</u></b></p> <ul style="list-style-type: none"> <li>• Circuit breaker or contactor module designation / bus no.</li> <li>• Insulation resistance test (contacts open, breaker racked in position) <ul style="list-style-type: none"> <li>a) between each phase of bus : Mega ohm</li> <li>b) between each phase and earth : Mega ohm</li> <li>c) DC and AC control and auxiliary circuits : Mega ohm</li> <li>d) between each phase of CT / PT and between CT &amp; PT circuit if any : Mega ohm</li> </ul> </li> <li>• CT checks <ul style="list-style-type: none"> <li>a) CT ratio</li> <li>b) CT secondary resistance</li> <li>c) CT polarity check</li> </ul> </li> <li>1. Check for contact alignment and wipe.</li> <li>2. Check / test all releases / relays.</li> <li>3. Check mechanical interlocks.</li> <li>4. Check electrical interlocks.</li> <li>5. Check switchgear / control panel wiring.</li> <li>6. Check breaker / contactor circuit for : <ul style="list-style-type: none"> <li>a) Closing - local &amp; remote (wherever applicable)</li> <li>b) Tripping - local &amp; remote (wherever applicable)</li> </ul> </li> <li>1. Opening time of breaker / contactor.</li> <li>2. Closing time of breaker / contactor.</li> </ul> <p>[This proforma shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].</p>
<p><b>3.4</b></p>	<p><b><u>INSTALLATION OF CABLE NETWORK</u></b></p> <p>Cable network shall include power, control and lighting cables which shall be laid in underground trenches, hume pipe open trenches, cable trays, G.I. pipes, or on building structures as detailed in the relevant drawings, cable schedules or as per the client / consultant's instructions. Supply &amp; installation of cable trays, G.I. pipes / conduits, cable glands and sockets of both end isolators, junction boxes, remote push button stations, etc. shall be under the scope of the contractor.</p> <p><b><u>1.0 General requirements for handling cables:</u></b></p> <p>Before laying cables, this shall be tested for physical damage, continuity, absence of cross phasing, insulation resistance to earth and between conductors. Insulation resistance tests shall be carried out with 500 / 1000 V megger.</p>

The cables shall be supplied at site, wound on wooden drums as far as possible. For smaller length and sizes, cables in properly coiled form can be accepted. The cables shall be laid by mounting the drum of the cable on drum carriage. Where the carriage is not available, the drum shall be mounted on a properly supported axle, and the cable laid out from the top of the drum. In no case the cable will be rolled on as it produces kinks which may damage the conductor.

Sharp bending of cable shall be avoided. The bending radius for PVC insulated and sheathed, armoured cable shall not be less than 10 D, where "D" is overall diameter of the cable.

- While drawing cables through G.I. pipes, conduits, RCC pipes, ensure that size of pipe is such that, after drawing cables, 40% area is free. After drawing cables, the end of pipe shall be sealed with cotton / bituminous compound.
- High voltage (11 KV and above), medium voltage (240 V and above) and other control cables shall be separated from each other by adequate spacing or running through independent pipes / trays.
- Armoured cables shall never be concealed in walls / floors / roads without G.I. pipes, conduits or RCC pipes.
- Joints in the cable throughout its length of laying shall be avoided as far as possible and if unavoidable, prior approval of site engineer shall be taken. If allowed, proper straight through epoxyresin tight joint shall be made, without any additional cost.
- A minimum loop of 3 mtr. shall be provided on both ends of the cable, and on both ends of straight through cable joint. This additional length shall be used for fresh termination in future. Cable for this loop shall be paid for supply and laying.
- Cable shall be neatly arranged in the trenches / trays in such manner so that criss-crossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cable within the trenches / trays shall be the responsibility of the contractor.
- All cable routes shall be carefully measured and cable cut to the required lengths and undue wastage of cables to be avoided. The routes indicated in the drawings are indicative only and the same may be rechecked with the client / consultant before cutting of cables. While selecting cable routes interference with structures, foundations, pipelines, future expansion of buildings etc. should be avoided.
- All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tapes. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.
- Wherever cable rises from underground / concrete / masonry trenches to motors / switchgears / push buttons, these shall be taken in G.I. pipes of suitable size, for mechanical protection upto 300 mm. distance of concerned cable gland or as instructed by the client / consultant.
- The cable pass through foundation / walls of other underground structures, the necessary ducts for opening will be provided in advance for the same. However, should it become necessary to cut holes in existing foundation of structures the electrical contractor shall determine the location and obtain approval of the client / consultant before cutting is done.

## **2.0 LAYING OF CABLES (UNDERGROUND SYSTEM)**

Cables shall be so laid in trench that this will not interfere with other underground structure. All water pipes, sewage lines or other structures which become exposed by excavation shall be properly supported and protected from injury until the filling has been rammed solidly in places under and around them. Any telephone or other cables coming in the way are to be properly shielded / diverted as directed by the

owner / consultant.

- Cable shall be laid at minimum depth of 750 mm. in case of L.T. and 1200 mm. in case of H.T. from ground level. Excavation will be generally in ordinary alluvial soil. The width of trench shall be sufficient for laying of required no. of cables.
- Sand bedding 75 mm. thick shall be made below and above the cables. Layer of bricks (full size) shall be laid above sand bedding on the sides and above the of cables to cover cable completely. More than one cable can be laid in the same trench by providing a brick on edge between two cables. However, the relative location of cables in trench shall be maintained till termination. The surface of the ground after back filling the earth shall be made good so as to conform in all respects to the surrounded ground and to the entire satisfaction of the client / consultant.
- For all underground cables, route markers should be used :

Separate route markers should be used for LT, HT and telephone cables.

- Route markers should be grounded in ground with 1:2:4 cement concrete pedestal size 230 x 230 x 300 mm.
- Cable markers should be installed at an interval not exceeding 30 mtr. along the straight routes of cables at a distance of 0.5 mtr. away from centre of cable with the arrow marked on the cable markers plate indicating the location of cable. Cable markers should also be used to identify change in direction of cable route and for location of every joint in underground cable.
- RCC hume pipe for crossing road in cable laying shall be provided by employer. No deduction shall be made for cable laying in hume pipe for not providing bricks, sand and excavation. RCC hump pipe at the ends shall be sealed by bituminous compound after laying and testing of cables by electrical contractor without any extra charge.

### **1.0 LAYING OF CABLE IN MASONRY TRENCHES**

Masonry / concrete trenches for laying of cables shall be provided by employer. However, steel members such as M.S. angles / flats etc. shall be provided and grouted by electrical contractor to support the cables without any extra charge. Cables shall be clamped to these supports with minimum saddles / clamps. More than one tier of cables can be provided in the same trench if the no. of cables is more.

Entry of cables in trenches shall be sealed with bituminous MASTIC compound to stop entry of water in trenches.

### **2.0 LAYING OF CABLES IN CABLE TRAYS**

- Cable trays and steel members such as M.S. angle / channel / flats etc. shall be provided and fixed by the erector.
- Cable shall be fixed in cable trays in single tier formation and cables shall be clamped with aluminium flat clamps and galvanised bolts / nuts.
- Earthing flat / wire can also be laid in cable tray along with cables.
- After laying of cables, minimum 20% area shall be spare.

### **3.0 TERMINATION AND JOINTING OF CABLES**

- a) For HT cables suitable size of Reychem termination kit shall be used.
- b) Use of glands:

All PVC cables upto 1.1 KV grade, armoured or unarmoured shall be terminated at the equipment / junction box / isolators / push buttons / control accessories, etc. by means of suitable size double compression type cable glands. Armour of cable shall be connected to earth point. The contractor shall drill holes for fixing glands wherever necessary. Wherever threaded cable gland is to be screwed into threaded opening of different size, suitable galvanised threaded reducing bushing shall be used of approved type.

In case of termination of cables at the bottom of the panel over a cable trench having no access from the bottom, close fit holes should be drilled in the bottom plate for all the cables in one line, then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables with glands, it shall be sealed with cold sealing compound.

- USE OF LUGS / SOCKETS

All cable leads shall be terminated at the equipment terminals, by means of crimped type solderless connectors unless the terminals at the equipment ends are suitable for direct jointing without lugs / sockets.

The following is the recommended procedure for crimped joints and the same shall be followed :

1. Strip off the insulation of the cable and with every precaution, not in severe or damage any strand. All insulation's to be removed from the stripped portion of the conductor and ends of the insulation should be clean and square.
2. The cable should be kept clean as far as possible before assembling it with the terminal / socket. For preventing the ingress of moisture and possibility of re-oxidation after crimping of the aluminium conductors, the socket should be filled with corrosion inhibiting compound. This compound should also be applied over the stripped portion of the conductor and the palm surface of socket.
3. Correct size and type of socket / ferrule / lug should be selected depending on size of conductor, and type of connection to be made.
4. Make the crimped joint by suitable crimping tool.
5. If after crimping the conductor in socket / lug, some portion of the conductor remains without insulation the same should be covered sufficiently with PVC tape.
6. For HT cable upto 11 KV the manufacturer's recommendation should be followed.

- DRESSING OF CABLE INSIDE THE EQUIPMENT

1. After fixing of cable glands, the individual cores of cable shall be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Cable shall be dressed in such a manner that small loop of each core is available inside the panel.
2. For motors of 20 HP and above, terminal box if found not suitable for proper dressing of aluminium cables, the erector shall modify the same without any additional cost.

**Cables inside the equipment shall be measured and paid for.**

- IDENTIFICATION OF CABLES / WIRES / CORES

1. Power cables shall be identified with red, yellow and blue PVC tapes. For trip circuits identification, additional red ferrules shall be used only in the particular cores of control cable at

the termination points in the switchgear / control panels and control switches.

2. In case of control cables all cores shall be identified at both ends by their wire numbers by mean of PVC ferrules or self-sticking cable markers, wire numbers shall be as per schematic / connection drawing. For power circuit also, wire numbers shall be provided if required as per the drawings of switchgear manufacturer / supplier.

- **TESTING OF CABLES**

1. Before energising, the insulation resistance of every circuit shall be measured from phase to ground. This requires 3 measurements if one side is grounded and 6 measurements for 3 phase circuits.
2. Where splices or terminations are required in circuits rated above 650 volts, measure insulation resistance of each length of cable before splicing and/or terminating. Repeat measurements after splices and/or terminations are complete.
3. DC high voltage test shall be made after installation on the following :
  - a) All 1100 volts grade cables in which straight through joints have been made.
  - b) All cables above 1100 V grade.

For record purpose test data shall include the measured values of leakage current versus time.

- The DC high voltage test shall be performed as detailed below :
- Cables shall be installed in final position with the entire straight through joints complete. Terminations shall be kept unfinished so that motors, switchgear, transformer etc. are not subjected to test voltage.
- The test voltage and duration shall be as per relevant codes and practices of Indian Standards Institution.

**PROFORMA FOR TESTING CABLES**

**DATE OF TEST**

- |                                     |          |
|-------------------------------------|----------|
| a) Drum No. from which cable taken. |          |
| b) Cable from                       | to       |
| c) Length of run of this cable      | meter    |
| d) Insulation resistance test       |          |
| i) between core-1 to earth          | mega-ohm |
| ii) between core-2 to earth         | mega-ohm |
| iii) between core-3 to earth        | mega-ohm |
| iv) between core-1 to core-2        | mega-ohm |
| v) between core-2 to core-3         | mega-ohm |

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p>vi) between core-3 to core-1 mega-ohm</p> <p>vii) duration used : 1 KV</p> <p>e) High voltage test Voltage Duration</p> <p>i) between core an earth.</p> <p>ii) between individual cores</p> <p>[This proforma shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].</p>
<b>4.0</b>	<b><u>EARTHING NETWORK</u></b>
<b>4.1</b>	<p><b><u>INSTALLATION AND CONNECTION</u></b></p> <ul style="list-style-type: none"> <li>The plate/pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case not less than 3 M below finished ground level.</li> <li>The plate/pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall / column.</li> <li>The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture.</li> <li>19 mm. dia. G.I. pipe for watering, shall run from top edge of the plate / pipe electrode to the mid-level of block masonry chamber.</li> <li>Top of the pipe shall be provided with G.I. funnel and screen for watering the earth / ground through the pipe.</li> <li>The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber.</li> <li>The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.</li> <li>Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation.</li> <li>The earth conductors (Strips / Wires copper / Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanised Iron clamps and Mild Steel Zinc Passivated screws / bolts. The conductors outside the building shall be laid atleast 600 mm. below the finished ground level.</li> <li>The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.</li> <li>Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.</li> <li>The earth conductors shall be in one length between the earthing grid and the equipment to be earthed</li> </ul>
<b>4.2</b>	<p><b><u>EARTH LEADS AND CONNECTIONS</u></b></p> <ul style="list-style-type: none"> <li>Earth lead shall be bare copper or Galvanised steel as specified with sizes shown on drawings.</li> </ul>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p>Copper lead shall have a phosphor content of not over 0.15 %. G.I. strip buried in the ground shall be protected with bitumen and hessian wrap or polythene faced hessian and bitumen coating. At road crossing necessary hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is atleast 8 mm away from the wall surface.</p> <ul style="list-style-type: none"> <li>The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.</li> </ul>
<b>4.3</b>	<p><b><u>TEST</u></b></p> <p>The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS: 3043.</p> <ul style="list-style-type: none"> <li>The following earth resistance values shall be measured with an approved earth megger and recorded.</li> <li>Each earthing station</li> <li>Earthing system as a whole</li> <li>Earth continuity conductors</li> <li>Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 5 ohm in each case.</li> <li>Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.</li> <li>All tests shall be carried out in presence of the Pmc</li> </ul>
<b>5.0</b>	<p><b><u>CONCEALED / SURFACE CONDUIT WORKS</u></b></p>
<b>5.1</b>	<p><b><u>LAYING OF CONDUITS</u></b></p> <p>Conduits shall be laid before casting in the upper portion of a slab / in PCC if below flooring or otherwise, as may be instructed in accordance with approved drawings, so as to conceal the entire run of conduits and ceiling outlet boxes. Conduits shall be so laid that they are interconnected. This is required to facilitate pulling of wires from different openings in case of any of the outlet is blocked during slab casting. Vertical drops shall be cut by the contractor to sufficient depth to allow full thickness of plaster over conduits. The width of the chases will be made to accommodate the required number of conduits. The chases will be filled with cement, coarse</p> <ol style="list-style-type: none"> <li>When the conduit is to be embedded in a concrete member it shall be adequately tied to the reinforcement to prevent displacement during casting. Tie wire to be supplied by the contractor.</li> <li>Cutting of chases in any RCC member / finished floor / already finished surface is not allowed unless prior approval of Site Engineer is taken in site instruction book. If a chases is cut in an already finished surface, the contractor shall fill the chases and finish it to match the existing finish including painting at his cost to Site Engineer's satisfaction.</li> <li>Contractor shall not cut any iron bars to fix the conduits. Puncher of wooden / steel shuttering for RCC slab / beams / column etc. for conduit work is also not allowed, unless Site Engineer permits in site instruction book under special conditions.</li> <li>Run of conduit pipe through expansion joints in RCC members should be avoided as far as possible and if unavoidable, flexible conduit pipe should be used with ceiling outlet box on both sides of expansion joints.</li> <li>Conduit on surface of RCC walls / RCC members shall be avoided as far as possible and if</li> </ol>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p>unavoidable prior approval of Site Engineer on sample saddles, clamps screws and a minimum 5 mtr. conduit laid on surface shall be taken, to achieve best possible workmanship. Distance between 2 consecutive clamps for fixing conduit on surface shall not exceed 900 mm. wooden patties for fixing saddles / clamps shall be used. Use of roll plug / steel fastener with hard setting / sealing compound is recommended.</p> <p>6. In case of stone masonry, necessary conduits with M.S. boxes should be placed as the masonry is in progress, since after completing masonry, it is very difficult to cut chases in wells. Special location of cement concrete shaft is also recommended to conceal conduit in stone masonry and the same shall be provided by client / consultant.</p> <p>7. In ground floor conduiting below the flooring should be avoided. Wherever it is unavoidable G.I. pipe should be used with prior approval of Site Engineer.</p>
<b>5.2</b>	<p><b><u>CEILING / WALL OUTLET BOXES FOR LIGHTS / FANS</u></b></p> <p>1. Outlet boxes shall be of steel with aluminium cover and so installed as to maintain continuity throughout. These shall be protected at the time of laying by filling with jute / earth / cotton etc. so that no cement mortar finds its way inside during concreting or plastering etc. Typical sketches for such outlet boxes shall be supplied alongwith other working drags. In beams conduit socket shall be provided in place of outlet boxes. The same shall be used for installation of luminaire.</p> <p>2. For fixing light fixtures / brackets, outlet boxes complete with check nut for holding conduits shall be used. For lighting fixture suitable for 20 watts fluorescent tubes / incandescent lamps / mercury vapour lamps, only one outlet box is required. For fixing lighting suitable for 40 watts fluorescent lamps, two numbers outlet boxes should be provided at a distance of 300 mm. away from the centre in the longitudinal direction of the fixture, so that the use of patties / roll plug etc. may be avoided, as well as wiring from outlet box to the light fitting is to be installed in RCC beam and due to heavy reinforcement at the bottom of beam it is not possible to provide outlet boxes simple conduit should be provided. However alternative fixing arrangement shall be made in consultation with client / consultant.</p> <p>3. For fixing ceiling fans, circular outlet boxes, 100 mm. diameter, complete with 12 mm. dia. Mild Steel rod 300 mm. long, for holding 12 mm. dia. Mild Steel cover 125 mm. dia. at bottom shall be used.</p>
<b>5.3</b>	<p><b>1. DRAW OUT JUNCTION BOXES</b></p> <p>2. Steel drawout boxes at angle dimensions shall be provided at a convenient points on walls / ceilings to facilitate pulling of long runs of cables / wires. These shall be completely concealed with Anodised Aluminium, flush with plaster works. These draw boxes should be five sided. The location of these boxes is to be decided prior to fixing, as per site requirement and following should be treated as general guidance for deciding the location of these :</p> <p>3. These should be provided at a place where these are not in direct view. Recommended place is 400 / 450 mm. below ceiling, if conduits are running vertically.</p> <p>4. Junction box in the offset of bottom of RCC beam and vertical wall should not be provided.</p> <p>5. If junction boxes are coming side by side for two or more conduits, one common M.S. box of proper size can be used to act as junction box.</p> <p>6. If junction box is to be provided in ceiling, its position should be so located that it is in line with other light / fan points.</p> <p>7. Junction boxes should never be used for splitting one conduit into two or more. Junction box for such functions is avoidable and for this, number of conduits to be connected to one switch board</p>



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p>should be calculated correctly as per drawing before laying conduits in ceiling.</p> <ol style="list-style-type: none"> <li>8. Locating junction boxes on outer surface of exterior walls of building should be avoided as these are in direct view and are also exposed to weather.</li> <li>9. Junction boxes should never be closed permanently by plaster. Removable covering of aluminium should be provided for conduit junction boxes for M.S. junction boxes removable hylem plate should be provided. This cover may be painted with wall colour.</li> <li>10. Junction boxes in important areas should be avoided and can be located in toilets / corridors / service shafts and stores etc.</li> </ol>
<b>5.4</b>	<p><b><u>SWITCH BOXES</u></b></p> <p>Steel boxes of required sizes, shall be provided to house speed regulators of fans, switches for lights, fans, plug sockets etc. as per requirement of drawings. These should be so designed that accessories on Anodised aluminium sheet could be mounted with tapped holes and brass machine screws, leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on all walls of the boxes through which the conduits are entering. These shall be completely connected leaving edges flush with finished wall surfaces. Anodised aluminium cover should be fixed to these switch boxes by means of brass chrome plated machine screws and cup washers. Utmost care shall be taken by contractor to ensure that all switch boxes are in line and level.</p> <p>Inside each switch box, one bolt shall be welded to receive earthing wire.</p>
<b>5.5</b>	<p><b><u>SWITCH AND SOCKET</u></b></p> <p>Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings.</p> <ul style="list-style-type: none"> <li>• The switch controlling the light point or fan shall be connect on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators shall be fixed inside the switch boxes on adjustable flat M.S. strips / plates with tapped holes and brass machine screws, leaving ample space at the back and side for accommodating wires.</li> <li>• The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws.</li> <li>• Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets and regulators.</li> <li>• The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit</li> <li>• The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission.</li> </ul>
<b>5.6</b>	<p><b><u>CLEANING AND PROTECTION OF CONDUIT SYSTEM</u></b></p> <p>The entire conduit system including outlet boxes, junction boxes and switch boxes shall be thoroughly cleaned after completion of erection and tested for not blockage by air / sound or steel wire prior to finishing of building by air / sound or steel wire prior to finishing of building and before drawing in of</p>

	<p>cables / wires to safeguard conduit system against filling up with the plaster / cement slurry / water etc. all the outlet and switch boxes will have to be provided with temporary jute / cotton filling, covers and plugs etc.. Within tendered cost which shall be replaced later on by hylem / sheet cover after wiring as required.</p>
<b>5.7</b>	<p><b><u>TESTING OF INSTALLATION</u></b></p> <p>Before a completed installation is put into service, the following tests shall be complied with:</p> <p><b><u>INSULATION RESISTANCE</u></b></p> <p>The insulation resistance shall be measured by applying 500 volt megger with all fuses in places, circuit breaker and all switches closed.</p> <p>The insulation resistance in gegohms of an installation, measured shall not be less than 50 megohms divided by the number of points on the circuit.</p> <p>The insulation resistance shall be measured between</p> <ul style="list-style-type: none"> <li>• EARTH TO PHASE</li> <li>• EARTH TO NEUTRAL</li> <li>• PHASE TO NEURAL</li> <li>• PHASE TO PHASE</li> </ul> <p><b><u>EARTH CONTINUITY PATH</u></b></p> <p>The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker, measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm.</p> <p><b><u>POLARITY OF SINGLE POLE SWITCHES</u></b></p> <p>A test shall be made to verify that every no-linked, single pole switch is connected to one of the phase of the supply system.</p> <p><b><u>COMPLETION CERTIFICATES</u></b></p> <p>All the above tests shall be carried out in presence of client and the results shall be recorded in prescribed forms. Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result from shall be submitted to the client for approval.</p> <p>On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.</p>
<b>6.0</b>	<b><u>INSTALLATION OF LIGHTING FIXTURES / FANS</u></b>
<b>6.1</b>	<p><b><u>INSTALLATION OF LIGHTING FIXTURES</u></b></p> <p>Scope of work under this item shall start from light point, with a 5 A bakelite connector, 2 core 1.5 mm.<sup>2</sup> PVC insulated wires from this connector to the connector inside the lighting fixture, connections, fixing of lighting fixture complete with all accessories, lamps on wall / roof / steel truss etc. testing the lighting</p>

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

	fixture and commissioning. If wire length of light point is enough to reach connector of light fitting, connector in light point can be deleted.
<b>6.2</b>	<p><b><u>INSTALLATION OF EXHAUST FANS</u></b></p> <p>Scope of work under this system shall start from exhaust fan point, with a ceiling rose, 2 core 2.5 mm.<sup>2</sup> PVC insulated wire from ceiling rose to connector of exhaust fan, connections, making fan opening in walls including repair / finishing fixing of exhaust fan complete with accessories and louvers on walls withhold-fasts, testing the exhaust fans and commissioning.</p>
<b>7.0</b>	<p><b><u>INSTALLATION OF EXTERNAL LIGHT FIXTURES</u></b></p>
<b>7.1</b>	<p><b><u>BRACKET FOR STREET LIGHT FITTINGS</u></b></p> <p>The brackets shall be made of 38 mm. NB MS class “B” pipe approx. 1.8 mtr. long bent at the centre at an angle 120° C. with necessary holding brackets, hold fasts etc. with special reducer at the end to accommodate type of street light fitting to be fixed. Bracket shall have 1 coat of anti-corrosion paint before despatch to site and 2 coats of approved make and shade of aluminium paint. This bracket shall also be provided with one M.S. water tight box complete with the connector, neutral link, rewirable fuse etc.. See enclosed drawings of street light poles.</p>
<b>7.2</b>	<p><b><u>INSTALLATION OF POLES</u></b></p> <p>Installation of poles shall be done as per enclosed drawings of street light poles. The depth of pole to be buried in ground shall be 1/5th of the total pole length or as specified in drawing, whichever is more. Special care shall be taken in erecting poles so that these are not strained or damaged during erection and are firmly stayed till the foundation are secured. The pole shall be grouted inside ground pit (cross-section 600 x 600 mm.) with cement concrete 1:2:4. Before the placement of concrete around pole in the pit, necessary conduit pipes (not less than 25 mm. dia.) shall be placed for facilitating drawing of cables. Separate conduit shall be provided for incoming and outgoing cables. The cement concrete shall be protected from prematured drying by curing for atleast 7 days after pouring. All concrete surface from 150 mm. below ground level to top shall be finished smooth with cement mortar 1:4.</p>
<b>7.3</b>	<p><b><u>INSTALLATION OF STREET LIGHT FIXTURES</u></b></p> <p>This includes fixing of street light fittings complete with accessories and lamps at the end of the pole / bracket, connecting it with 3 x 2.5 mm.<sup>2</sup> aluminium conductor, PVC insulated cable from water tight M.S. box, testing, commissioning. Third core shall be connected with earthing point of light fitting at one end and earthing point of marshalling box at the other end.</p>
<b>7.4</b>	<p><b><u>GENERAL NOTES FOR STREET LIGHTING</u></b></p> <ol style="list-style-type: none"> <li>1. For supplying and laying of cables, technical specification (wiring) shall be applicable reference shall be made under heading Cable Work elsewhere in the tender.</li> <li>2. For street light poles along roads, nearest finished road level shall be taken as ground level and for poles along compound wall / away from roads, existing ground / finished ground shall be taken as ground level.</li> <li>3. Distance of 1 mtr. shall be maintained between centre of pole and centre of curb of road. For</li> </ol>

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

	<p>compound wall poles, distance between compound wall and poles shall be 3 mtrs.</p> <p>4. A loop of 1.5 mtr. of cable shall be provided near each street light pole for all incoming and outgoing cable.</p>
<b>8.0</b>	<b><u>COMPLETION TESTS</u></b>
<b>8.1</b>	<p>After supply and installation of complete project or a particular building / area, following tests shall be carried out by the contractor before switching on the power to installation and the results shall be recorded and submitted to the Site-Engineer. If results are not satisfactory / as per standards set herewith, the contractor shall identify the defects / short coming and shall rectify the same. Nothing extra shall be paid for carrying out these tests and contractor has to arrange all necessary instruments.</p>
<b>8.2</b>	<p><b><u>INSULATION RESISTANCE TO EARTH</u></b></p> <p>This is to be measured with all fuse links in place, all switches ON, all lamps and appliances in position by applying a voltage not less than twice the working voltage (subject to a limit of 500 V). Insulation resistance of the whole or any part of the installation to earth must not be less than 50 mega-ohms divided by the number of outlets (points and switch positions) except that it need not exceed one mega-ohm for the whole installation.</p>
<b>8.3</b>	<p><b><u>INSULATION RESISTANCE BETWEEN CONDUCTORS</u></b></p> <p>Tests to be made between all the conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or neutral or the other pole or phase conductors of the supply. For this test, all lamps shall be removed and all switches put ON. The result of the test must be 50 mega-ohms divided by the number of outlets (points and switch positions) but need not exceed 1 mega-ohm for the whole installation.</p>
<b>8.4</b>	<p><b><u>POLARITY OF SINGLE POLE SWITCHES</u></b></p> <p>Tests shall be made to verify that all non-linked single pole switches are on phase conductor (live) and not on neutral or earth conductor. This can be done by connecting test lamps between two terminals of switch and earth. If the lamp lights up when switch is ON and either terminal is touched, the switch is correctly installed.</p>
	<p><b><u>RESISTANCE OF METAL CONDUITS / SHEETS (EARTH CONTINUITY TEST)</u></b></p> <p>In case of cables encased in metal whether conduit of metallic sheathing, the total resistance of the conduit or sheathing from the earthing point any other position in the completed installation shall not exceed 2 ohms. This can be carried out by following circuit :</p> <p>One end of the lead is connected to the ECC and its connection with the electrode and the other to the farthest point of the ECC. First, current through the circuit is measured with the resistance of 2 ohms short circuited by the link. Next, current is measured through the two ohms resistance by disconnecting the two leads from the ECC and joining them together. If current is more in the first case, the resistance of ECC is less than 2 ohms.</p>
<b>9.0</b>	<b><u>HANDING OVER / TAKING OVER</u></b>

<b>9.1</b>	After completion of works and tests specified above, the various building of the project can be taken over by the employer as and when these are ready in all respects. However, the defect liability period of 12 months would start from the date, when all the buildings of the project have been completed and handed over, unless employer agrees for defect liability period in phased due to non-completion of civil work of few buildings for which electrical contractor is not responsible.
<b>1.10</b>	<b>HANDING OVER / TAKING OVER</b>
	<p>The Tenderer shall indicate the makes of tools, test equipment and other item listed below:</p> <ol style="list-style-type: none"> <li>1. TOOLS <ol style="list-style-type: none"> <li>A. Set of spanners of sizes 6 mm to 32 mm width across flat <ul style="list-style-type: none"> <li>• Adjustable wrench of 36 mm jaw width</li> <li>• Adjustable wrench of 23 mm jaw width</li> </ul> </li> <li>B. Heavy duty screw driver with full size insulated handle and blade length of <ul style="list-style-type: none"> <li>• 100 mm</li> <li>• 50 mm</li> <li>• 200 mm</li> </ul> </li> </ol> </li> <li>2. TEST EQUIPMENT <ol style="list-style-type: none"> <li>A. 2500 V megger motor operated</li> <li>B. 500 V megger hand operated</li> <li>C. Multimeter (Battery operated) satisfying the following <ul style="list-style-type: none"> <li>• With 0-1 mA, 0-100 mA, 0-1A and 0-5A, AC &amp; DC current ranges</li> <li>• With 0-100 mV, 0-3V, 0-30 V, 0-300 V and 0-1000V AC &amp; DC voltage ranges</li> <li>• The resistance ranges shall be atleast five (0-100) m ohm, (0-1) Ohm, (0-10) Ohm, (0-100) Ohm, (0-100) mega ohm</li> <li>• The Input impedance shall not be less than one mega Ohms for voltage ranges</li> </ul> </li> </ol> </li> <li>3. LADDERS <p>Ladder shall be made out of light aluminium alloy of good strength. They shall be of step ladder, foldable, self supporting type with spreader of metallic angles or high strength nylon straps. The ladder shall be provided with shoes on bottom of legs. Rugs shall be flat type having thickness of 30 mm in case of 3 meters long ladders and 60 mm for 6 metres long ladder.</p> <ul style="list-style-type: none"> <li>• 3 metres long</li> <li>• 6 metres long</li> </ul> </li> <li>4. Tong tester - ammeter range 0 to 30, 150 &amp; 300 Amps AC and voltmeter (0-600) V, class 1.0 with leads and leather case.</li> </ol>

<b>8.0 TECHNICAL SPECIFICATIONS FOR UPS</b>	
	<p><b><u>TECHNICAL SPECIFICATIONS FOR SUPPLY OF STATIC UNINTERRUPTIBLE POWER SUPPLY-Three Phase</u></b></p>
	<p><b><u>Scope</u></b></p> <p>The Contractor shall furnish and install a three-phase continuous duty, on-line, double conversion, solid-state uninterruptible power system, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning, back-up and distribution/ termination for critical electrical loads. The UPS shall consist of, as required by the project, the UPS module, battery cabinet(s), and accessory or "option" cabinet(s) for transformers, maintenance bypass, parallel tie, and distribution applications, and other features as described in this specification.</p>
	<p><b><u>UPS Description</u></b></p> <ul style="list-style-type: none"> <li>• Standard UPS will include a minimum of (1) rectifier, (1) inverter, (1) static bypass, and (1) battery system.</li> </ul> <p><b><u>Components:</u></b></p> <ul style="list-style-type: none"> <li>• Rectifier</li> <li>• Inverter</li> <li>• With In built isolation transformer</li> <li>• Sealed Lead Acid Batteries</li> <li>• Battery Charger</li> <li>• Static Bypass</li> <li>• User Interface Panel</li> <li>• Serial (RS-232)/USB Communication Interface for service use</li> <li>• Communication Card Slots (2)</li> <li>• Environmental (Building Alarm) Inputs (3)</li> <li>• Hardwired / flexible cu cables Input, Output</li> <li>• External Battery Cabinets (or racks)</li> <li>• Communications Options</li> <li>• SNMP/Web adapter</li> <li>• RS-232 and relay contact interface</li> <li>• Modbus RTU interface</li> </ul> <p><b><u>Modes of Operation:</u></b></p> <p>The UPS shall operate as an online, double-conversion UPS with the following modes:</p> <p><b><u>Normal:</u></b></p> <p>During the Normal or Double-conversion Mode the rectifier shall derive power as needed from the commercial AC utility or generator source and supply filtered and regulated DC power to the online inverter. The inverter shall convert the DC power to highly regulated and filtered AC power for the critical loads.</p> <p><b><u>Battery:</u></b> Upon failure of the AC input source, the critical load must continue to be supplied by the inverter without switching. The inverter must obtain its power from the battery. There must be no interruption in power to the critical load upon failure or restoration of the AC input.</p> <p><b><u>Recharge:</u></b> Upon restoration of the AC input source, the rectifier/battery charger must recharge the battery. The inverter shall, without interruption of power, regulate the power to the critical load.</p>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p><b>High Efficiency:</b> The static bypass switch will conduct, and the UPS rectifier and inverter will be operated in a “suspended” mode, unless incoming power conditions require conventional double conversion operation. In High Efficiency mode the UPS input and output filters shall remain in-circuit to provide surge suppression. Transfer time from HE mode to Double Conversion mode, and vice versa, shall be typically less than 4ms.</p> <p><b>Bypass:</b> The static bypass switch must be used for transferring the critical load to the AC utility supply without interruption, and shall be rated for continuous operation. Automatic re-transfer to normal operation must also be accomplished without interruption of power to the critical load. The static bypass switch must be capable of manual operation via the front panel controls. An optional integrated bypass back-feed protection contactor, in series with the static switch, shall prevent system voltages from bleeding backwards through the static switch and rectifier snubber components to the utility source in the event of a utility failure and shall also open upon detection of a short circuit static bypass SCR.</p> <p><b>Optional internal load testing / Self test:</b> The UPS system will be capable of utilising the Easy Capacity Test (ECT) function, including internally adjustable load testing at the customer site, without the need for a load bank.</p>
	<p><b>REFERENCES</b></p> <p>The UPS and all components shall be designed, manufactured and tested in accordance with the latest applicable standards as follows. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.</p> <p style="padding-left: 40px;">Safety</p> <p style="padding-left: 80px;">a. IEC 62040 or EN 62040</p> <p style="padding-left: 80px;">b. EN 60950</p> <p style="padding-left: 40px;">Emission and Immunity:</p> <p style="padding-left: 80px;">c. IEC62040-2-C3 (conducted and radiated)</p> <p style="padding-left: 80px;">d. EN61000-4,-5, level 4 – 4 kV L-PE, 2kV L- Electrostatic discharge (ESD): 8 kV air discharge, 4 kV contact discharge (IEC 61000-4-2, level 4) - Electromagnetic field: IEC 61000-4-8 level 3.</p>
	<p><b>SUBMITTALS – FOR REVIEW/APPROVAL</b></p> <p>Submit one copy of a concise operation and maintenance manual.</p>
	<p><b>SUBMITTALS – FOR CONSTRUCTION</b></p> <p>Submit one copy of a concise operation and maintenance manual.</p>
	<p><b>QUALIFICATIONS</b></p> <p style="padding-left: 40px;">A. The manufacturer of the unit shall have a minimum of forty / thirty years’ experience in the design, manufacture and testing of Uninterruptible Power Supplies.</p> <p style="padding-left: 40px;">B. For the equipment specified herein, the manufacturer shall be ISO 9001 certified for engineering/R&amp;D and manufacturing facilities.</p> <p><b>REGULATORY REQUIREMENTS</b></p> <p>The UPS shall be CE marked.</p>
	<p><b>DELIVERY, STORAGE AND HANDLING</b></p>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	Equipment shall be handled and stored in accordance with manufacturer's instructions. The UPS and accessory cabinets meet structural requirements of ASTM D4169. One (1) copy of these instructions shall be included with the equipment at time of shipment.
	<p><b>OPERATION AND MAINTENANCE MANUALS</b></p> <p>Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component products.</p>
	<p><b>RATINGS</b></p> <p><b>System Rating</b></p> <p>The UPS module(s) shall have an output rating of :10 KVA ,20 KVA,30 KVA.</p> <p><b>System Input</b></p> <ul style="list-style-type: none"> <li>• Input Voltage Operation Range <ul style="list-style-type: none"> <li>Nominal 400/230 (or 380/220 or 415/240 adjustable) VAC, 4-wire plus ground</li> <li>-15% to +20% from nominal at 100% load -50% to +20% from nominal at 50% load</li> </ul> </li> <li>• Input Frequency <ul style="list-style-type: none"> <li>a. 42 to 70 Hz auto-sensing</li> </ul> </li> <li>• Input Power Factor: 0.99 typical</li> <li>• Input Current Distortion: 5% THD maximum at full rated linear load</li> <li>• Inrush Current: <ul style="list-style-type: none"> <li>a. ≤120% of rated current for ≤2 cycles</li> </ul> </li> </ul> <p><b>System Output, Normal Mode -Nominal Output Voltage, UPS on Utility</b></p> <ul style="list-style-type: none"> <li>• 400/230, or 380/230 or 415/240VAC, Selectable through front panel or through serial port connection with power management software</li> <li>• Output power factor rating: 0.7 lagging to 0.9 leading without de-rating.</li> <li>• Voltage regulation: +/-1% of selected output voltage in steady state</li> </ul> <p>Transient Voltage Response: Meets Class 1 performance of IEC62040-3 and VFI-SS-111; +/-5% for 100% step load change; recovery in &lt;20ms.</p> <p><u>Voltage THD:</u></p> <ul style="list-style-type: none"> <li>- 2% Total Harmonic Distortion (THD) maximum phase to neutral into a maximum rated linear load (5% phase to phase)</li> <li>- 5% THD maximum phase to neutral and phase to phase into a non-linear load</li> </ul> <p><u>Nominal Frequency:</u> 50 or 60 Hz selectable</p> <p><u>Frequency Regulation:</u></p> <p>50/60 Hz +/- 4Hz, +/-1 to +/- 4 Hz selectable, synchronised to mains, +/- 0.005 Hz free running (single module) or +/- 0.07 Hz (parallel system)</p> <p><u>Slew rate:</u></p> <p style="padding-left: 40px;">0.5 Hz per second</p> <p style="padding-left: 40px;">Selectable up to 7 Hz/s for single units,&lt;0.5 Hz/s for parallel units</p> <p style="padding-left: 40px;">Generator Mode (6 / 7 Hz/s) for single units selectable through software parameters that can be configured via LCD and service PC interface</p>



**Output Current:**

Full load output current (at nominal output voltage) for the UPS shall be:

Example : 200 kVA system: 289 A @ 400 V

**Current Overload Capability without Bypass:**

102-125% for 10 min

126-150% for 1 min

>151% for 150 ms

Short Circuit conditions: current limit at 2.5x nominal FL current for 300 ms./ 1.5x nominal FL current for 500 ms (as per UPS Capacity)

**Current Overload Capability with Bypass enabled:**

102-125% for 10 min

126-150% for 1 min

>151% for 150 ms

Short Circuit conditions: immediate transfer to bypass; then 115%/ 100% continuous, with transient capability of 10x nominal for 20 ms.

**Bypass:**

Automatic bypass shall provide an alternate path to power in the case of overload, inverter failure or other UPS failure

Transfer time to and from any internal bypass shall be no-break, when UPS and Utility are in sync

Unit shall be able to detect bypass module failure.

**Efficiency:**

In Normal Mode, 100% linear load, with nominal line condition:  $\geq 94.0/93.0\%$

In Normal Mode, 75% linear load, with nominal line condition:  $\geq 93.8\%$

In Normal Mode, 50% linear load, with nominal line condition:  $\geq 93.0\%$

In High Efficiency mode:  $\geq 98\%$  at 100% linear load;  $\geq 97\%$  at 50% linear load

**System Output, Battery Mode**

Nominal Output Voltage: This shall be the user-selected output voltage

Voltage Regulation:  $\pm 1\%$  phase to neutral of selected nominal voltage ( $\pm 2\%$  phase to phase)

Transient Voltage Response

Meets Class 1 performance of IEC62040-3

$\pm 5\%$  for 100% step load change; recovery in  $< 20\text{ms}$

Voltage THD:

2% Total Harmonic Distortion (THD) maximum into a maximum rated linear load

5% THD maximum phase to neutral into a maximum rated non-linear load (7.5% phase to phase)

Frequency Regulation:  $\pm 0.1\text{ Hz}$  of selected nominal frequency

Current Overload Capability

102-125% for 1 min

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p style="text-align: center;">126-150% for 30 sec &gt;151% for 150 ms</p>
	<p><b>CONSTRUCTION</b></p> <p>The UPS system is initially provided as a single-module, non-redundant system. The UPS shall be field-upgradeable with additional parallel capacity up to 3+0 modules, or for redundant operation, up to 3+1 modules.</p> <p>Single UPS modules shall be capable of parallel operation and shall not require any hardware modifications in order to be paralleled with other modules in future.</p> <p><u>Converter (rectifier):</u> Incoming power shall be filtered and converted to DC by a sine-wave rectifier. The rectifier utilises IGBT technology to correct the input power factor to 0.99 and draws sinusoidal current (with less than 5% THD) from the utility. In the event of utility failure, the DC-DC converter shall be supplied power without interruption from the external batteries. In the event of utility sag down to -50% of nominal voltage the UPS shall continue to operate at up to 100% load in a power share mode that draws power from the utility and the battery.</p> <p><u>Inverter:</u></p> <p style="padding-left: 40px;">The inverter utilises IGBT technology and Digital Signal Processing to convert the DC power from the rectifier or converter to regulated AC power for output to critical loads.</p> <p>Output Voltage: The inverter output voltage is specified in section 1.12.B.</p> <p>Voltage Regulation: The inverter steady state voltage regulation is +/- 1% phase to neutral, 2% phase to phase. Dynamic regulation meets Class 1 performance of IEC62040-3.</p> <p>Frequency Control: The inverter steady state frequency regulation is +/-0.1 Hz, free running in steady state. UPS is synchronised to the Utility bypass in normal operation.</p>
	<p><b>MECHANICAL CONSTRUCTION</b></p> <p>All materials and components of the UPS shall be new, of current manufacture, and shall not have been in prior service except as required during factory testing. The UPS shall be constructed of replaceable subassemblies. All active electronic devices shall be solid-state.</p> <p>The UPS unit is comprised of an input rectifier, battery charger, inverter, bypass, and battery consisting of the appropriate number of sealed battery modules, and shall be housed in a single freestanding enclosure. The UPS cabinet shall be cleaned, primed, and painted with the manufacturer's standard color. Wheels and leveling feet shall be provided as standard on systems.</p> <ol style="list-style-type: none"> <li>1. The UPS cabinet shall have a rating of IP20.</li> <li>2. The UPS shall be designed for forced-air cooling. Air inlets shall be on the front of the unit and shall be fitted with washable dust filters. Air outlets shall be at the rear. A minimum of 600mm rear clearance for ventilation and access to terminations for systems.</li> <li>3. Cable access shall be through the front bottom or rear of the UPS cabinet</li> <li>4. Dimensions of standard UPS cabinets</li> </ol>
	<p><b>SYSTEM INPUT &amp; OUTPUT CONNECTIONS</b></p> <p><u>AC Input:</u></p> <ul style="list-style-type: none"> <li>• All UPS units shall be capable of utilising hardwired input. Input, Bypass, and/or output</li> </ul>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p>terminals may be placed in Option cabinets as determined by system configuration. Wiring between Option or external battery cabinets and UPS to be supplied by others. Input &amp; output terminals are available inbuilt for flexible cu cables to avoid un necessary termination in external cubicle. - DC cables will be in numeric scope.</p> <ul style="list-style-type: none"> <li>• The building/Utility input neutral is required for proper UPS operation unless input transformer option is used. - We have suggested inbuilt transformer to avoid un necessary termination and isolator in external cubicle.</li> </ul> <p><u>AC Output:</u></p> <ul style="list-style-type: none"> <li>• All UPS units shall be capable of utilising hardwired output</li> </ul> <p><u>Extended Battery Connection:</u></p> <p>UPS module will include terminations for External battery cabinets, if used.</p> <p><u>Remote Emergency Power Off (REPO) Connection:</u> The UPS shall provide a built-in landing for field connection of a Remote Emergency Power Off circuit. Upon initiation of the REPO circuit, the UPS shall open its input relays, and disengage the battery converter, preventing power from being delivered to the attached loads.</p> <p><u>Serial (RS-232) Communication Interface:</u> A 9-pin sub-D connector and USB connector shall provide capability for communicating with manufacturer's servicing software package. The UPS shall also provide plug-in communication options to provide signals for remote indication of UPS alarm status.</p> <p><u>Communication Card Slots:</u> The UPS shall provide (2) communication mini-slots in the front of the UPS allowing for optional plug-in connectivity options, including SNMP/Web interface, 4x relay contacts &amp; RS232 port, and Modbus capabilities.</p> <p><u>Programmable Input Connections:</u> The UPS shall provide built-in inputs for field connection (environmental input). The inputs shall be parameter programmable to suit the needs of the application.</p>
	<p><b>USER INTERFACE</b></p> <p>Front Panel Display: The UPS shall include a front panel display consisting of a graphical LCD display with backlight, four status LED's, and a six-key keypad.</p> <p>Graphical LCD display: Includes basic language (English and local selectable language), display of unit function and operating parameters. It shall be used to signify the operating state of the UPS, for indicating alarms, for changing operations control parameters and set points.</p> <p>Four status LED's, which indicate:</p> <ol style="list-style-type: none"> <li>Alarms, with a red LED</li> <li>On Battery, with a yellow LED</li> <li>On Bypass, with a yellow LED</li> <li>Power On, with a green LED</li> </ol> <p>Six-Key Multifunction Keypad: UPS shall have keypad to allow user to adjust UPS parameters, view alarm and inverter logs, change UPS operational modes, and turn the UPS on and off. Keys will be marked as UP, DOWN, LEFT, RIGHT, ESC and ENTER</p> <p>Meters: When selected, the front display shall show individual screens of input parameters, output parameters or bypass parameters including; voltage, current, frequency, true power, apparent power and power factor. The display shall also show DC Voltage and current.</p> <p>Power Management Software Package: The UPS shall offer optional communications interface</p>

	<p>that provides the following communication capabilities:</p> <ul style="list-style-type: none"> <li>• Monitor and graphically display input and output voltage and other operating characteristics</li> <li>• Notify end-users in the event of a power anomaly via network, E-mail or page.</li> <li>• Communication Ports: <ul style="list-style-type: none"> <li>a. Communication Card Slots: The UPS shall provide (2) communication mini-slots in the back of the UPS allowing for additional connectivity options, including SNMP/Web interface, 4x relay contacts, and RS-232 capabilities.</li> <li>b. Serial communications (via RS-232 or USB) with manufacturer's service software package</li> </ul> </li> </ul>
	<p><b>BATTERIES</b></p> <p>Battery Type: 12V, Valve Regulated Lead Acid (VRLA), 10 year standby design life at 25°C with minimum two-year warranty.</p> <p>Holdover Time (Runtime): Each UPS system shall have the option of capability for matching battery cabinets to increase the holdover time. Please refer to datasheet for a list of runtimes. The battery times listed there are approximate and may vary depending on load configuration, temperature, battery age, and state of battery charge.</p> <p>Battery Recharge Time: UPS system will have a typical recharge time of 10 times the length of the outage to 90% usable capacity @ nominal line voltage. As per battery manufacturer recommendation.</p> <p>Battery Protection:</p> <ul style="list-style-type: none"> <li>• Short Circuit Protection: Over-current protection shall protect the batteries from all short circuit fault conditions</li> <li>• Battery Module Protection: Internal battery contactor shall be provided</li> <li>• Under-voltage Protection: Battery operation shall be terminated when the battery voltage drops to the 1.67 VPC set point</li> <li>• Over-voltage Protection: If the UPS system's battery bus voltage exceeds the predetermined set point then the UPS will disable the charger and alarm a "check battery" condition</li> </ul> <p>Battery Management System:</p> <p>The UPS shall contain a battery management system which has the following features:</p> <ul style="list-style-type: none"> <li>• The battery management system shall charge the batteries using an intermittent charging cycle. The active battery charger states are constant-current (charge mode), constant-voltage (float mode) and no-charge (rest mode). The charge mode shall equalise and charge the batteries to near full capacity before entering into float mode. In float mode a constant voltage float charge shall charge the batteries for a minimum of 48 hours or until the batteries are fully charged. The batteries are then put into rest mode. The battery shall be monitored whilst in rest mode and the charge cycle shall automatically re-start should the battery voltage drop below pre-determined levels. The charging control system shall activate an alarm should the battery capacity drop below the pre-determined levels. The charge cycle will automatically restart after a utility disturbance. The batteries shall not be physically disconnected from the</li> </ul>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p>UPS DC bus during the charge cycle and shall be available at all times to supply the inverter.</p> <ul style="list-style-type: none"> <li>• Battery Runtime Monitoring: UPS shall monitor batteries and provide status to end user of battery remaining capacity via front panel icon, remote communications, or both. Runtime calculations to be based on load demand and analysis of battery health.</li> <li>• Battery Health Monitoring: / Battery Bank Self test : UPS shall periodically test and monitor battery health and provide warnings visually, audibly and/or remotely when battery capacity falls below 80% of original capacity. Battery testing may also be user initiated via front panel or serial communications.</li> </ul>
	<p><b>NAME PLATES</b></p> <p>Provide a printed nameplate for each ups.</p>
	<p><b>ENVIRONMENTAL CONDITIONS</b></p> <p>The UPS shall meet IEC 61000-4-6 Level 3, and IEC 62040-2 C3, and FCC A15J for Emissions</p> <p>Audible Noise:</p> <ul style="list-style-type: none"> <li>• Less than or equal to 70 dB (A weighted) at one (1) metre from all sides in normal mode at less than or equal to 75% load.</li> </ul> <p>Ambient Temperature</p> <ul style="list-style-type: none"> <li>• Operating: UPS: 0 deg C to +40 deg C, (preferred temperature for batteries: 15 to 25 deg C.</li> <li>• Storage: UPS -25 deg C to +55 deg C.</li> <li>• Transportation: -25 to 60 deg C</li> </ul> <p>Relative Humidity</p> <ul style="list-style-type: none"> <li>• Operating: 5 to 95% non-condensing.</li> <li>• Storage: 5 to 95% non-condensing.</li> <li>• Transportation: 5 to 95% non-condensing</li> </ul> <p>Altitude</p> <ul style="list-style-type: none"> <li>• Operating: To 1000 metres, de-rating or reducing operating temperature range may be required for higher altitudes</li> <li>• Transit: To 10,000 metres</li> </ul> <p>Electrostatic Discharge: The UPS shall be able to withstand a minimum 8 kV without damage and without affecting the critical load</p>
	<p><b>EXECUTION</b></p> <p>FACTORY TESTING IF APPLICABLE</p> <p>The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.</p> <ul style="list-style-type: none"> <li>• Standard Computer-automated UPS system test</li> <li>• Hipot test</li> </ul>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p><b>INSTALLATION</b></p> <p>The Contractors shall install all equipment per the manufacturer's recommendations.</p> <p><b>FIELD QUALITY CONTROL</b></p> <p>Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section for a period of XX working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.</p> <p>The Contractor shall provide three (3) copies of the manufacturer's field start-up report.</p>

### SPECIFICATIONS OF 60KVA/80KVA/100KVA

UPS Capacity / Rated Power	60 KVA/80kva/100kva
<b>Configuration</b>	Stand Alone
Battery Backup Time	30minutes per UPS @ full load with 0.8 power factor
Full Load Current in Ampere	Vendor to specify
Load Power Factor	Unity Preferred
Number of Phase	3 Phase, 4 Wires
Type of Rectifier	IGBT Based DSP technology
<b>Input characteristics</b>	
<b>Design</b>	IGBT Rectifier
Nominal voltage	415V (3 ph + N)
Tolerance on voltage	-15% to +20%
Nominal frequency	50HZ
Tolerance on frequency	45-65
Input power factor	≥ 0.99
Total harmonic distortion (THDi)	<3%
Walk in /Soft start	1 to 90
Rectifier Hold OFF (Sec)	1 to 180
<b>Inverter output characteristics</b>	
<b>Design</b>	IGBT PWM Inverter
Nominal voltage	415V (3 ph + N) 380V/400V selectable
Nominal frequency	50HZ
Inbuilt Galvanic Isolation transformers	Vendor has to be provided
Power factor	0.9 pf minimum, Unity Preferred

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

Nominal power @ 40°C (KVA)	Vendor has to be provided KVA
Nominal Power @ 40°C (KW)	Vendor has to be provided KW
Output voltage stability in steady-state condition for input within permitted limits and load variations from 0 to 100% - Balance Load 100%	$\leq 1\%$
For Unbalanced Load 100%	$\leq 2\%$
Stability in dynamic conditions for 100% load step variations	Complies with IEC/EN 62040-3, Class 1
Load crest factor without derating	03:01
Output voltage distortion with 100% linear load	$<1$
Output voltage distortion with linear load as specified by IEC/EN 62040-3	$< 2 \%$
Output voltage distortion with non-linear load as specified by IEC/EN 62040-3	$< 3 \%$
Output frequency stability in synchronization with mains ( $\pm 2 \pm 3 \pm 4$ selectable)	1+/-
Output frequency stability with internal clock	0.1 +/-
Frequency slew rate	$<1$
<b>Permitted overload:</b>	
for 60 seconds	150%
for 10 minutes	125%
<b>Battery technical Specifications</b>	
Make	As per BOM
VAH	As per BOM
Battery Type	12 V SMF
Battery Charger	Vendor has to be specified DC Ripple without battery
Battery Voltage	Minimum 480 Vdc
Battery Current	Vendor has to be specified
Battery back-up Time	30 Minutes@0.8 power factor
Battery Sizing	Vendor has to be submitted as per VAH
<b>Characteristics of electronic static changeover switch</b>	
Nominal voltage (380/415 selectable)	400V
Tolerance on voltage	20+ / -15
Nominal frequency	50HZ
Tolerance on frequency	1 +/-
<b>UPS characteristics</b>	
Maximum UPS cabinet dimensions WxHxD	Vendor has to be provided
UPS weight with Transformer	Vendor has to be provided
Noise level @ 1 meter as ISO 3746 and @ 100% load	$< 70$ dBA

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

AC/AC efficiency – double conversion mode @ 100% Load	≥ 93% with transformer
Heat Load of UPS with Transformer	Heat dissipation: - Float mode with nominal load : - Recharge mode: - Digital interactive with nominal load:
<b>Standards</b>	
EMC compatibility as per EN 62040-2	EN 50091-2 Class RS IEC 62040 - 2
Degree of protection	IP 20
Cable Entry	Front Bottom
Safety	IEC 62040 - 1
Testing	IEC 62040 - 3
Frame colour	As per manufacturer
Communication - SNMP Card & MODBUS	Vendor has to be provided
Factory Acceptance Test - FAT - Indian Origin Manufacturer	Vendor has to be offered Inspection
Drawing Documents approval before Manufacturing Clearance	Vendor has to be provided
Type Test Certificates along with Offer submission	Vendor has to be provided
Manufacturer should follow Quality Assurance Plan & Inspection Test Plan	As per Attached ITP Documents
Successful Installation in PIU	Vendor has to be provided
Post Order Drawing Submission for Manufacturing clearance	Vendor has to submit - SLD, GA, Power & Control Wiring Diagram & Foundation Details

**ANY DEVIATION IN ABOVE DATA SHEET SHALL BE SUBJECT TO APPROVAL FROM CONSULTANT AND CLIENT. THE DEVIATION SHALL BE REJECTED IF TECHNICALLY NOT IN LINE WITH REQUIRED.**

DETAILED TECHNICAL SPECIFICATIONS OF 10/30 KVA UPS	
<b>UPS Capacity / Rated Power</b>	<b>10 KVA / 9 KW , 30kva / 27kw</b>
<b>Configuration</b>	Stand Alone
Battery Backup Time	30minutes per UPS @ full load
Full Load Current in Ampere	Vendor to specify
Load Power Factor	0.9
Number of Phase	3 Phase, 4 Wires
Type of Rectifier	IGBT Based DSP technology
<b>Input characteristics</b>	
<b>Design</b>	IGBT Rectifier
Nominal voltage	415V (3 ph + N)
Tolerance on voltage	305V to 470V
Nominal frequency	50HZ



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

Tolerance on frequency	40-70 HZ
Input power factor	$\geq 0.99$
Total harmonic distortion (THDi)	<5%
Walk in /Soft start	Vendor to specify
Rectifier Hold OFF (Sec)	Vendor to specify
<b>Inverter output characteristics</b>	
<b>Design</b>	IGBT PWM Inverter
Nominal voltage	415V (3 ph + N) 380V/400V selectable
Nominal frequency	50HZ
Inbuilt Galvanic Isolation transformers	Vendor has to be provided
Output Power factor	0.9
Nominal power @ 40°C (KVA)	Vendor has to be provided KVA
Nominal Power @ 40°C (KW)	Vendor has to be provided KW
Output voltage stability in steady-state condition for input within permitted limits and load variations from 0 to 100% - Balance Load 100%	$\leq 1\%$
For Unbalanced Load 100%	$\leq 2\%$
Stability in dynamic conditions for 100% load step variations	Complies with IEC/EN 62040-3, Class 1
Load crest factor without derating	03:01
Output voltage distortion with 100% linear load	<1
Output voltage distortion with linear load as specified by IEC/EN 62040-3	< 2 %
Output voltage distortion with non-linear load as specified by IEC/EN 62040-3	< 5 %
Output frequency stability in synchronization with mains ( $\pm 2 \pm 3 \pm 4$ selectable)	$\pm 0.25$
Output frequency stability with internal clock	$\pm 0.25$
Frequency slew rate	<1
<b>Permitted overload:</b>	
150%	for 60 seconds
125%	for 5 minutes
105%	for 60 minutes
<b>Battery technical Specifications</b>	
Make	As per BOM
VAH	
Battery Type	12 V SMF
Battery Charger	Vendor has to be specified DC Ripple without battery
Battery Voltage	Minimum 480 Vdc
Battery Current	Vendor has to be specified
Battery back-up Time	30 Minutes
Battery Sizing	Vendor has to be submitted as per VAH

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>Characteristics of electronic static changeover switch</b>	
Nominal voltage (380/415 selectable)	400V
Tolerance on voltage	vendor to specify
Nominal frequency	50HZ
Tolerance on frequency	10 +/- default
<b>UPS characteristics</b>	
Maximum UPS cabinet dimensions WxHxD	Vendor has to be provided
UPS weight with Transformer	Vendor has to be provided
Noise level @ 1 meter as ISO 3746 and @ 100% load	<58
AC/AC efficiency – double conversion mode @ 100% Load	≥ 93% with transformer
Heat Load of UPS with Transformer	Heat dissipation: - Float mode with nominal load : - Recharge mode: - Digital interactive with nominal load:
<b>Standards</b>	
EMC compatibility as per EN 62040-2	IEC 62040 - 2
Degree of protection	IP 20
Cable Entry	Front Bottom
Safety	IEC 62040 - 1
Testing	IEC 62040 - 3
Frame colour	As per manufacture
Communication - SNMP Card & MODBUS	Vendor has to be provided
Factory Acceptance Test - FAT	Vendor has to be provided
Drawing Documents approval before Manufacturing Clearance	Vendor has to be provided
Type Test Certificates along with Offer submission	Vendor has to be provided
Manufacturer should follow Quality Assurance Plan & Inspection Test Plan	As per Attached ITP Documents
Successful Installation in PIU	Vendor has to be provided
Post Order Drawing Submission for Manufacturing clearance	Vendor has to submit - SLD, GA, Power & Control Wiring Diagram & Foundation Details

**ANY DEVIATION IN ABOVE DATA SHEET SHALL BE SUBJECT TO APPROVAL FROM CONSULTANT AND CLIENT. THE DEVIATION SHALL BE REJECTED IF TECHNICALLY NOT IN LINE WITH REQUIRED.**

**09.0 TECHNICAL SPECIFICATIONS FOR ELECTRICAL SOLAR POWER GENERATION**

**SCOPE OF WORK**

The following section of the document describes the scope of work for 10 kWp Grid connect Photovoltaic system at your proposed building. This job involves by means of the enclosed specification, design, manufacture, supply, installation & commissioning of the Solar PV Power Plant with 1 year warranty period.

The Scope of Work shall include the following,

- Design, manufacture, supply of Solar PV Power Plant
- Detailed planning of smooth execution of the project
- Performance testing of the complete system
- Warranty of the system for 1 year faultless operation.
- After sales service, directly or through local contractual arrangement
- Risk liability of all personnel associated with implementation and realization of the project

**Assumption on the Proposal**

- The module layout is proposed on the basis of clear open shadow free space available on the building roof top at your proposed Office building. The shadow free clear south facing area required for Module Mounting for this 10 KWp SPV plant is approx 2000 Sq.FT
- The Power Conditioning Unit (Central inverter), DCDB, Metering panel, Isolation panel are housed inside the proposed control room, to be constructed at site
- There shall be non interrupted grid power available from 6.00 am to 7.00 pm throughout the year.

**3.1 SYSTEM DESCRIPTION**

The Photovoltaic (PV) Grid connect system consists mainly of 3 components: The PV array, Module Mounting Structure and the Power conditioning Unit (PCU). The PV array converts the light energy in to sunlight to direct current (DC) power. The Module mounting structure is used to hold the module in position. The DC power is converted to alternating current (AC) power by the PCU, and exported to utility power grid.

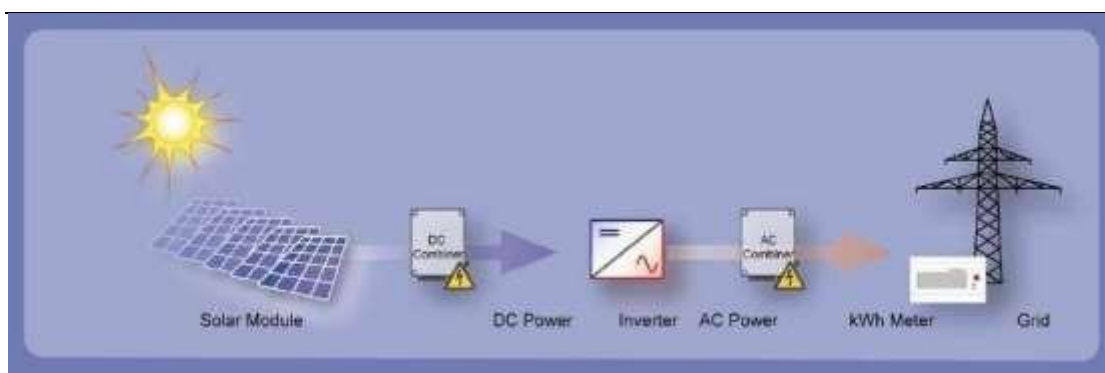


Fig: System Schematic

The multi crystalline solar modules used are grouped in an optimum number of strings with module-to module cable connections.

The modules are held fixed on structures made of galvanized steel structures. The modules are inclined at optimum horizontal tilt angle facing due south depending on the site location.

The DC output from the modules is fed to Array junction box and the strings are paralleled at Sub Main & Main Junction Boxes.

The output of the main junction box is fed to DC distribution board (DCDB).

The DC power output from the DCDB is fed to the Power Conditioning Unit (PCU)

The Power conditioning unit installed in a control room converts DC energy produced by the solar array to AC energy. The AC power output of the inverter shall be fed to the AC Distribution Board (metering panel & isolation panel) which also houses energy meter. The 415V AC output of the isolation panel is fed to the grid or as an option it could be stepped up to the required voltage level through power transformer and fed to the grid. AC energy is then synchronised with the grid and power is exported to the grid.

#### DATA SHEET FOR SOLAR POWER GENERATION

SUPPLY		kWp	10
No		Qty	UoM
1	Solar Module: TPS superior quality ranging 240 Wp , 245 Wp, 250 wp based on	As per site	Set
2	Module mounting structure (fixed tilt-30 Degree)	As per site	Set
3	Grid Interactive Solar Inverter (1 x10KW, 415V AC, 50Hz, MPPT	As per site	No
4	Temperature and irradiance sensor 30 Meter CAT-6 Cable	As per site	Set

# TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

5	AC Distribution Board with Multi data meter	As per site	No
6	1C X 4 Sq.mm. P.V.C Cu.cable (Array Interconnection & to Inverter)	As per site	M
7	5 Core, 6SQMM P.V.C Cu.cable (Inverter to AC combiner box)	As per site	M
8	3.5C X 16 Sq.mm. P.V.C Alcable (ACDB to LT Panel)	As per site	M
9	Multi Contact Male cable coupler	As per site	No
10	Multi Contact Female cable coupler	As per site	No
11	Earthing kit (Chemical)	As per site	set
12	GI Strip (25mm x 5 mm)	As per site	set
13	Vertical Air terminal	As per site	set
14	Installation kit	As per site	set

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

10.0 CABLE MANAGEMENT SYSTEM METAL RACE WAY , UPVC TRUNKING & SENSORS	
<b>1.0</b>	<b>METAL TRUNKING</b>
1	<p>GI Trunking made up of Pre Galvanized sheet metal with zinc coated steel sheet double folded and arc welded. The double folding ensures that the impact resistant is high and no concrete seepage occurs. Material Specification: As per BS2989 (Indian Standards IS 277:2003).Tensile Strength: 500N/m<sup>2</sup>.The material thickness should be 1.6mm with a standard length of 2.5mtrs.The trunking should be Compartmentalized for provision of data, power and voice cables. The MTRaks also has their respective joint sleeves, which acts as couplers to join the lengths. Size and compartments shall be as per tender boq.</p> <p>The joint sleeves too come with pre galvanized sheet steel material with double folding. The joint sleeves are provided with fixing screws on the top cover to tighten the trunking lengths.</p>
2	<p>Access outlets, manufactured from high-pressure die cast material trap cover made of flame retardant Engineering Plastic - ABS &amp; Polyamide ratchet. Trap cover must be reinforced with a 2.5mm thick pre-galvanized steel plate with a recess of 8mm.The trap cover must be provided with Electrostatic Polyester Epoxy Coating. The trap cover also comes with the double grommet openings for input cable connections. The base of the box is made of pre-galvanized sheet steel with a thickness of 1mm. The base box has a provision to accommodate three compartment trunking to run Mains Voltage &amp; Extra Low Voltage cables. The system must have Positive Double Earthing Connections. The base box has the provision to accommodate 25/38mm deep trunking with a Knockout up to 225mm width. The box comes with the accessory tray with power and data plates pre-fixed. These accessory plates can accommodate a maximum of up to 17modules. Height adjustment: The system must have the bar level adjusting ratchets Dimension. Load bearing Capacity: Up to 2 tons . Size and dimensions shall be as per tender boq.</p>
3	<p>Cross Overs boxes manufactured from high-pressure die cast material. The Trap Cover &amp; Trap frame of the box should be made of 2.5mm thick pre-galvanized steel plate made of Electrostatic Polyester epoxy coating. The recess should be 8mm on the trap lid to accommodate the specified flooring The cross over boxes should have flyover units made of ABS plastic or metal to route and distribute power, data and voice cables. The system must have smooth curved die cast pillars for ease of pulling cables. The base of the box is made of pre-galvanized sheet steel with a thickness of 1mm. The system must have the provision to accommodate 25/38mm deep GI trunking, with width knockouts to accommodate trunkings from a minimum of 50mm up to a maximum of 300mm. Height adjustment: The system must have the stainless steel levelling screws. Load bearing Capacity: Up to 3.6 tons on the trap lid Standards: The system must comply with the relevant specification &amp; IEC 61084 . Sizes and dimensions as per the tender boq</p>
4	<p>Supply of heavy duty <b>access outlets with snorkel cord outlet</b>, manufactured from high pressure die cast material. The system must be <b>wet washable</b> with <b>IP44</b> rating. The system must be CAT6 Compliant with a space of 40mm below and 27mm above the accessory</p>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	plates. The trap frame should be made of strong pre-galvanised sheet steel. Rubber gaskets should be provided wherever the gaps need to be filled to prevent any seepage during installation or water, while cleaning. The system must have provision to accommodate three compartment trunking to run Mains Voltage & Extra Low Voltage cables. The system must have Positive Double Earthing Connections. The system must have the provision to accommodate 38mm deep trunking with a knockout of up to 225mm. The box should consist of staggered accessory plates to relieve the strain relief, even when international moulded plug tops are used. The trap lid should have the provision to accommodate 15mm thick flooring and should be strong enough to withstand heavy objects. <b>Height adjustment:</b> M8 screws are provided to attain the desired height <b>Load bearing Capacity:</b> 10000N as per BSEN50085-2-2.
5	Supply of <b>Cable link plus access outlets</b> , manufactured from high pressure cast die cast material. <b>Trap cover</b> must be reinforced with a 2.5mm thick pre-galvanized steel plate with a recess of 8mm. The trap cover also comes with the double grommet openings for input cable connections. The grommets have the flexibility to be opened at 90/45 degree, depending on the no.of input cables. The system must be CAT6 Compliant with a wiring space of 40mm below and a plug top clearance of 27mm above the accessory plates. The trap frame should be made of strong nylon material. Self-closing lid for safety in accordance with new standard IEC 61534. The base of the box is made of pre-galvanized sheet steel with a thickness of 1mm. The base box has a provision to accommodate three compartment trunking to run Mains Voltage & Extra Low Voltage cables. The system must have Positive Double Earthing Connections. The base box has the provision to accommodate 25/38mm deep trunking with a Knockout up to 225mm width. The box comes with the accessory tray with power and data plates pre-fixed. The accessory plates are arranged in a staggered manner to ensure strain relief on the cables, once connected. <b>Height adjustment:</b> The system must have the on/off locking mechanism for height adjustment. <b>Bearing Capacity:</b> 5000N as per EN50085-2-2.
6	Supplying of L Shaped Vertical access boxes to connect the floor raceways to wall equipment. The vertical access boxes are epoxy coated and has provision to connect floor raceways in the bottom and other cable management products on the top side vertical. The system must have the provision to accommodate 38mm deep trunking with a knockout of up to 250mm.
7	Supplying of L Shaped Vertical access boxes to connect the floor raceways to wall equipment. The vertical access boxes are epoxy coated and has provision to connect floor raceways in the bottom and other cable management products on the top side vertical. The system must have the provision to accommodate 38mm deep trunking with a knockout of up to 250mm.
8	Supplying of desktop pop up boxes in brushed steel/gold finish. The top cover is made of stainless steel material whereas the base box is of aluminium alloy. The top cover can be closed, when not plugged-on, by a press button, which is provided on the cover frame. The accessory cover frame is provided with modular cut-outs with a maximum of 6 module accommodation of MK wraparound wiring accessories. A combination of 2 nos of 6amp

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p>sockets with a 6amp switch and RJ45/RJ11 can be fixed. The base box has conduit opening with a depth up to 60mm. Positive earthing terminals are provided for safety.</p> <p><b>Dimension: 125*125*60mm deep</b></p> <p><b>Colour: brushed steel finish</b></p>
<b>9</b>	<b>Cable Management System</b>
<b>10</b>	<p>Supply of <b>Cable Management System</b>- Prestige 3D to distribute power, data and telecom cables. The system should comply with all relevant sections of the latest edition of IEE wiring regulations and shall be CAT 6 compliant. The system shall comprise of base &amp; lid with snap-fit lid and allied accessories such as data sweep, cable retainers, flat angle, flat tee etc. The three compartment system shall have cross sectional dimensions of 170mm height and 57mm in depth and with a wall thickness of 1.7mm on lid and 2mm on cover. The main carrier should be pre-drilled at 300mm centres with a divider knockout after every 100mm intervals. Material should be non flame prorogation and a Class 1 spread of flame achieved when tested in accordance with the requirements of BS EN 50085-1:1999 and BS EN 61386-1:2004. The System shall have provision to accept mounting boxes that snap fit in to the profile and that accessories and internal angle, external angle ,joint cover with end cap</p> <p><b>Main carrier --- 170mm (H) * 57mm (D)</b></p> <p><b>Straight cover</b></p> <p><b>Curved cover</b></p> <p><b>Material: U-PVC Colour: White Standard Length: 3mtrs</b></p>
<b>11</b>	<p>Supplying of <b>Cable Management System</b>- Prestige 3D Antibac blue to distribute power, data and telecom cables. The system is designed to kill bacteria which grow on the trunking surfaces. The system uses silver based additive inherent within the Upvc which acts as an effective weapon in fighting harmful bacteria. The system complies with all relevant sections of the latest edition of IEE wiring regulations and is CAT 6 compliant.</p> <p>The system comprises of base &amp; lid with snap-fit lid and allied accessories such as data sweep, cable retainers, flat angle, flat tee etc. The three compartment system has a cross sectional dimension of 170mm height and 57mm in depth and with a wall thickness of 1.7mm on lid and 2mm on cover. The main carrier is pre-drilled at 300mm centres with a divider knockout after every 100mm intervals.</p> <p>Material is non flame prorogation and a Class 1 spread of flame achieved when tested in accordance with the requirements of BS EN 50085-1:1999 and BS EN 61386-1:2004.</p> <p>The System has the provision to accept mounting boxes that snap fit in to the profile. The accessories should be urea based, which can act as an antibacterial.</p> <p><b>Main carrier 170mm (H) * 57mm (D)</b></p>



	<p><b>Straight cover</b></p> <p><b>Curved cover</b></p> <p>Material: <b>U-PVC</b></p>
<b>12</b>	<p><b>SENSORS</b></p> <p>PIR presence detection sensor of range 8.0 m Dia coverage recessed mounting at height of 2.5 - 3 meter to control 10A lighting load. Manually Programmable for OFF delay time 10 sec- 40 min, Passive photocell Lux Sensing to sense ambient light level.</p> <p>Switch ON / OFF of luminaires based on occupancy &amp; ambient light. Open workstation, Cabins, Discussion rooms, Toilets, Pantry.</p> <p>PIR presence detection sensor of range 6.0 m Dia coverage recessed mounting at height of 2.4-3 meter to control 6A lighting load with 3 meter four core power cable. To be commissioned by hand held programmer with programmable features of delay time 5 min - 35 min, photocell and power up (status of luminaires when power is applied). It shall have provision to manually override luminary ON/OFF status using hand held remote control.</p> <p>Advance presence detection by Microwave technology. The sensor range is corner mount 20 meter X 20 meter at a recommended mounting height of 3.5 meter. To control lighting load of 10 A, with features of delay time 5- 20 min, Passive photocell and Dual Sensitivity for Range.</p> <p>Switch ON / OFF of luminaries based on occupancy &amp; ambient light.</p>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

11.0	<u>TECHNICAL SPECIFICATIONS FOR MEDIUM VOLTAGE PANEL</u>			
1.0	<u>SCOPE OF WORK</u>			
	This scope shall cover design, manufacture, check test, and supply of medium and low voltage motor/power control Panel boards, MCB distribution boards etc. as described in this specification, as per drawings and schedule of quantities.			
2.0	<u>CODES &amp; STANDARDS</u>			
	The Panels shall comply with the latest edition of relevant Indian Standards and Indian Electricity Rules and Regulations. The following Indian standards shall be complied with:			
	Sr.	Item	Relevant IS	Relevant IEC
	1.	General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC	IS: 4237	
	2.	Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.	IS: 375	
	3.	Degree of protection provided by enclosures for Low voltage switches gear and control gear.	IS: 2147	
	4.	Terminal marking for electrical measuring instrument and their accessories.	IS: 8197	
	5.	Danger notice plates	IS: 2551	
	6.	Code of Practice for selection, installation and maintenance of switchgear and control gear.	IS: 10118	
	7.	Specification for factory built assemblies of switchgear and control gear for voltage up to and including 1000 V AC and 1200 V D.C.	IS: 8623	
	8.	Miniature circuit breakers.	IS: 8828	
	9.	Current transformers	IS: 2705	
	10.	Voltage transformer	IS: 3155	
	11.	Electrical relay for protection	IS: 3231	
	12.	Indicating instruments	IS: 1248	

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<b>13.</b>	Integrating instruments	IS: 722	
	<b>14.</b>	Control switches and push buttons	IS: 6875	
	<b>15.</b>	AC motor starters of voltage not exceeding 1000 V	IS: 1822	
	The Panels also require approval of the client/consultant at various stage of their manufacture such as design, selection, construction, testing, shipping etc.			
<b>3.0</b>	<b><u>DESIGN BASIS &amp; SITE CONDITIONS</u></b>			
	Ambient Temperature : Max. / Min. = 50° C. / 6° C.			
	Design temperature : 50 Degree C.			
	Relative humidity : 95% max.			
	Altitude : 20 M above MSL			
	Voltage : 415+/- 10%, TPN			
	Frequency : 50 Hz. + 3% to -6%			
	Neutral : Solidly / earthed neutral.			
	Fault level : 24 MVA, Symmetrical at 415V solidly earthed.			
	All the equipment and components provided in the transformer and accessories shall be suitably designed for installation and satisfactory operation as specified below.			
	<b><u>Site conditions</u></b>			
	<b>Location</b> RAJPIPLA MEDICAL CAMPUS		RAJPIPLA	
	<b>Ambient temperature</b>		<b>Relative humidity</b>	
	Maximum 47° C		Maximum 98 %	
	Minimum 04° C		Minimum 40 %	
	Design 45° C		Design 98 % at 45 ° C	
	<b>Seismic factor</b> As per IS:1893		Rain fall 1000 mm/year	
	<b>Environmental</b> Tropical/humid/corrosive conditions		<b>Location of Equipment</b> Indoor	
	<b>Wind speed</b> 80 kmph maximum			

# TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	Electrical system data:			
	Power supply for Equipment			
	Voltage 415 kV ± 5 %		Frequency 50 Hz ± 3 %	
	Permissible combined voltage & frequency variation	± 6 %	System design faults level (Symmetrical)	35 kA – 50 KA – 65 KA for 1 sec. max. as per specified in SLD
	System earthing LV side neutral solidly earthed		Wiring 3 phase, 4 wire on 415V system	
	Auxiliary power supply :			
	Power supply		240V AC, 1-Ph, 50Hz	
	Control Supply		-----	
	Space heater power supply		240V AC, 1-Ph, 50Hz	
	Illumination power supply		240V AC, 1-Ph, 50Hz	
	Plug-socket power supply		240V AC, 1-Ph, 50Hz	
4.0	TECHNICAL REQUIREMENTS			
	All the Panels shall be metal clad, totally enclosed, rigid, floor mounting, air insulated, cubicle type suitable for operation on three phase/single phase, 415 V/240 V, 50 Hz., neutral effectively grounded at transformer and short circuit level as mentioned in the drawings.			
	The entire outdoor panel shall be double door type with IP54 protection class construction.			
	The entire indoor panel shall have IP51 protection class construction.			
	The painting of all the metal part shall be as per the painting specification defined in the datasheet.			
	The panel should be CPRI / ERDA approved with 85 KA short circuit withstand strength.			
	The Panels shall be designed to withstand heaviest condition at site, with maximum expected ambient temperature of 45°C, 90% humidity and salty, dusty weather.			
	CUBICAL TYPE PANELS:			
	STRUCTURE			

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	The Panels shall be metal clad enclosed and be fabricated out of high quality CRCA sheet, suitable for indoor installation having dead front operated and floor mounting type.
	All CRCA sheet steel used in the construction of Panels shall be 2 mm. thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet steel shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal.
	The Panels shall be totally enclosed, completely dust and vermin proof and degree of protection being not less than IP: 51. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasketed with foam rubber and/or rubber strips and shall be lockable.
	All panels and covers shall be properly fitted and secured with the frame and holds in the panel correctly positioned. Fixing screws shall enter into holes, taped into an adequate thickness of metal or provided with bolts and nuts. Self-threading screws shall not be used in the construction of Panels.
	A base channel of 100 mm. x 50 mm. shall be provided at the bottom. A clearance of 300 mm. between the floor of the Panels and the bottom of the lower most units shall be provided.
	Panels shall be preferably arranged in multi-tier formation. The Panels shall be of adequate size with a provision of 20% spare space to accommodate possible future additional switchgear. The size of the Panels shall be designed in such a way that the internal space is sufficient for hot air movement and the electrical component does not attain temperature more than 45 <sup>0</sup> c. The entire electrical component shall be derated for 50 <sup>0</sup> c. The ratings indicated in the drawing are derated for 50 <sup>0</sup> c.
	Knock out holes of appropriate size and number shall be provided in the Panels in conformity with the number, and the size of incoming and outgoing conduits/cables.
	Alternately, the Panels shall be provided with removable sheet steel plates at top and bottom to drill holes for cable/conduit entry at site.
	The Panels shall be designed to facilitate easy inspection, maintenance and repair.
	The Panels shall be sufficiently rigid to support the equipment without distortion under normal and under short circuit condition. They shall be suitably braced for short circuit duty.
	PROTECTION CLASS:
	All the indoor Panels shall have protection class of IP 51 for indoor installation and IP 54 for outdoor installation.
	PAINTING:
	The painting shall be with 2 coats of epoxy primer along with two coats of PU paint [Anti-corrosive paint]. Paint shade shall be confirmed with the client.

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	CIRCUIT COMPARTMENTS:									
	Each circuit breaker and switch fuse unit shall be housed in separate compartments and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker/switch fuse unit in `ON` and `OFF` position. Safety interlocks shall be provided for air circuit breaker to prevent the breaker from being drawn out when the breaker is in `ON` position.									
	The door shall not form an integral part of draw out position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barriers shall be provided between the tiers in a vertical section.									
	INSTRUMENT COMPARTMENTS:									
	Separate adequate compartment shall be provided for accommodating instruments, indicating lamps, control contactors/relays and control fuses etc. These components shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker/switch fuse unit, busbar and connections.									
	BUS-BARS:									
	The busbar shall be air insulated and made of high quality, high conductivity, high strength Aluminium.									
	The busbar shall be of 3 phases and neutral system with separate neutral and earth bar. The bus bar and interconnection between bus bars and various components shall be of high conductivity Aluminum. The busbar shall be of rectangular cross-section designed to withstand full load current for phase bus bars and half rated current for neutral bus bars and shall be extensible on either side. The busbar size shall be as per drawing. The busbar shall have uniform cross-section throughout the length.									
	The bus bars and interconnections shall be insulated with heat shrinkable PVC sleeve and be colour coded in red, yellow, blue and black to identify the 3 phases and neutral of the system if specified in datasheet. The busbar shall be supported on unbreakable, non-hydroscopic SMC/DMC insulated supports at sufficiently close intervals to prevent bus bars sag and shall effectively withstand electromagnetic stresses in the event of short circuit capacity of 15 KA RMS symmetrical for 1 sec. and a peak short circuit withstand of 31.5 KA minimum.									
	<p>The bus bar shall be housed in a separate compartment. The bus bar shall be isolated with 3 mm. thick Bakelite sheet to avoid any accidental contact. The bus bar shall be arranged such that minimum clearance between the bus bars to be maintained as below:</p> <table><tr><td>Between phases</td><td>:</td><td>25 mm. minimum</td></tr><tr><td>Between phases and neutral</td><td>:</td><td>25 mm.</td></tr><tr><td>Between phases and earth</td><td>:</td><td>25 mm.</td></tr></table>	Between phases	:	25 mm. minimum	Between phases and neutral	:	25 mm.	Between phases and earth	:	25 mm.
Between phases	:	25 mm. minimum								
Between phases and neutral	:	25 mm.								
Between phases and earth	:	25 mm.								

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	Between neutral and earth	: 20 mm. minimum	
	All bus bar connections shall be done by drilling holes in bus bars and connecting by chromium plated or tinned plated brass bolts and nuts. Additional cross-section of bus bar shall be provided in all Panels to cover up the holes drilled in the bus bar. Spring and flat washers shall be used for tightening the bolts.		
	All connections between bus bars and circuit breakers/switches and cable terminals shall be through aluminium strips of proper size to carry full rated current. These strips shall be insulated with insulating tapes.		
	<b><u>ELECTRICAL POWER AND CONTROL WIRING CONNECTION:</u></b>		
	Terminal for both incoming and outgoing cable connections shall be suitable for 1100 V grade, aluminum/copper conductor PVC insulated and sheathed, armoured cable and shall be suitable for connections of solder-less sockets for the cable size as indicated on the appended drawings for the Panels.		
	Power connections for incoming feeders of the main Panels shall be suitable for 1100 V grade aluminum conductor (LT XLPE) cables.		
	Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance.		
	Both control and power terminals shall be properly shrouded.		
	10% spare terminals shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block, so that not more than one outgoing wire is connected per terminal.		
	Terminal strips for power and control shall preferably be separated from each other by suitable barriers of enclosures.		
	Wiring inside the modules for power, control, protection and instruments etc. shall be done with use of 660/1100 V grade, PVC insulated copper conductor cables conforming to IS: 694 and IS: 8130. Power wiring inside the starter module shall be rated for full current rating of respective contactor, but not less than 4.0 sq.mm. Cross-section area. For current transformer circuits, 2.5 sq.mm. copper conductor wire shall be used. Other control wiring shall be done with 1.5 sq.mm. copper conductor wires. Wires for connections to the door shall be flexible. All conductors shall be crimped with solderless sockets at the ends before connections are made to the terminals.		
	Control power for the Motor starter module shall be taken from the respective module switchgear outgoing. Control power wiring shall have control fuses, (HRC fuse type) for circuit protection. All indicating lamps shall be protected by HRC fuses.		
	Particular care shall be taken to ensure that the layout of wiring is neat and orderly. Identification ferrules shall be fitted to all the wire termination for ease of identification and to facilitate checking		

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	and testing.
	Spring type washers shall be used for all copper and aluminium connections.
	Final wiring diagram of the Panels power and control circuit with ferrules numbers shall be submitted alongwith the Panels as one of the documents against the contract.
	<b><u>TERMINALS:</u></b>
	The outgoing terminals and neutral link shall be brought out to a cable alley suitably located and accessible from the panel front. The current transformers for instruments metering shall be mounted on the disconnecting type terminal blocks. No direct connection of incoming or outgoing cables to internal components of the distribution board is permitted; only one conductor may be connected in one terminal.
	<b><u>WIRE-WAYS:</u></b>
	A horizontal PVC wire way with screwed covers shall be provided at the top to take interconnecting control wiring between different vertical sections.
	<b><u>CABLE COMPARTMENTS:</u></b>
	Cable compartments of adequate size shall be provided in the Panels for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate supports shall be provided in the cable compartments to support cables. All outgoing and incoming feeder terminals shall be brought out to terminal blocks in the cable compartment.
	<b><u>EARTHING:</u></b>
	Copper earth bus of 40 X 6 mm shall be provided in the Panels for the entire length of the panel. The frame work of the Panels shall be connected to this earth bar. Provisions shall be made for connection from this earth bar on both sides of the panels to the main earthing bar coming from the earth pit. Door earthing shall be provided for all the compartments.
	The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp, and the clamp shall be made for connection from this earth pit on both sides of the Panels.
	The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp, and the clamp shall be ultimately bonded with the earth bar.
	<b><u>LABELS:</u></b>
	Engraved metal labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the distribution board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.



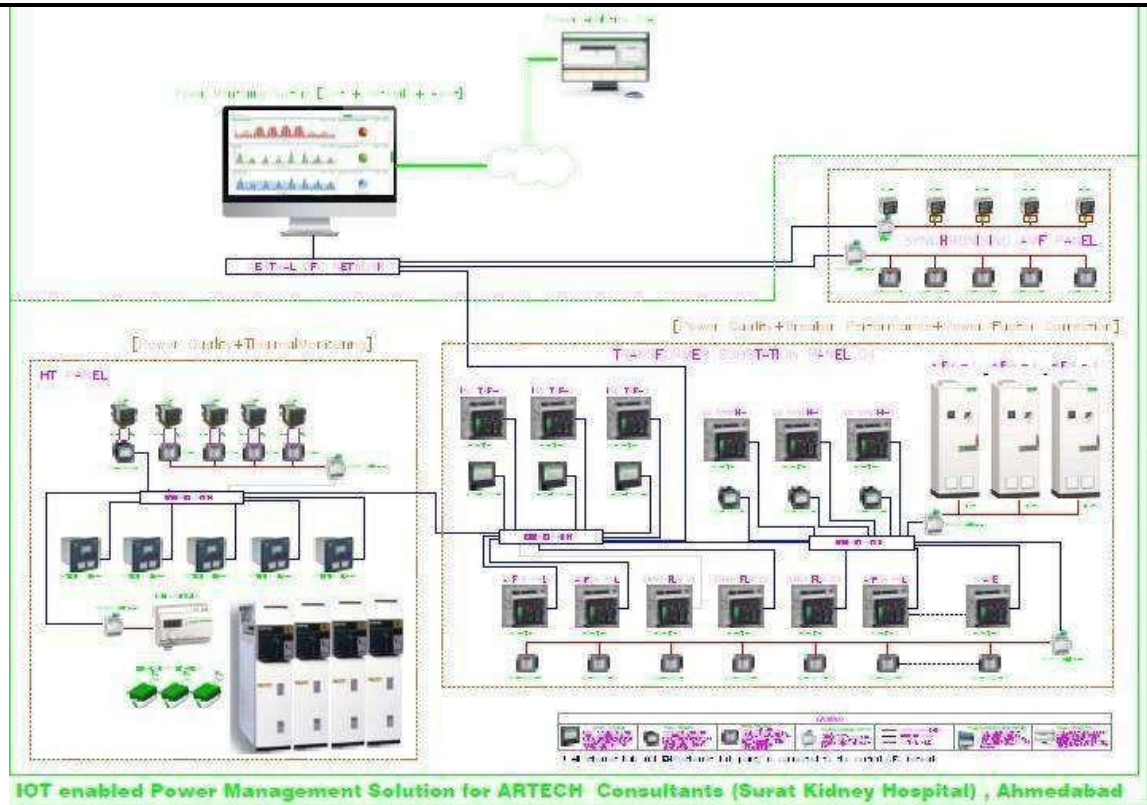
## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<b><u>NAME PLATE:</u></b>
	A name plate with the Panel's designation in bold letters shall be fixed at top of the central panel. A separate name plate giving feeder details shall be provided for each feeder module door.
	Inside the feeder compartments, the electrical components, equipments, accessories like switchgear, control gear, lamps, relays etc. shall suitably be identified by providing stickers.
	Engraved name plates shall preferably be of 3 ply,(Red-White-Red or Black-White-Black) lamicold sheet. However, black engraved Perspex sheet name plates shall also be acceptable. Engraving shall be done with square groove cutters.
	Name plate shall be fastened by counter sunk screws and not by adhesives.
	<b><u>DANGER NOTICE PLATES:</u></b>
	The danger notice plate shall be affixed in a permanent manner on operating side of the Panels.
	The danger notice plate shall indicate danger notice both in Hindi and English and with a sign of skull and bones.
	The danger notice plates, in general, meet the requirements of local inspecting authorities.
	Overall dimensions of the danger notice plate shall be 200 mm. wide x 150 mm. high.
	The danger notice plate shall be made from minimum 1.6 mm. thick mild steel sheet and after due pre-treatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.
	The letters, the figures, the conventional skull and bones etc. shall be positioned on plate as per recommendation of IS: 2551-1982.
	The said letters, the figures and the sign of skull and bones shall be painted in signal red colour as per IS: 5-1978.
	The danger plate shall have rounded corners. Location of fixing holes for the plate shall be decided to suit design of the Panels.
	The danger notice plate, if possible, is of ISI certification mark. Suitable Voltage rated rubber mates to be provided.
	<b><u>INTERNAL COMPONENTS:</u></b>
	The Panels shall be equipped complete with all types of required number of auto transformer starters, switch fuse units, contactors, relays, fuses, meters, instruments, indicating lamps, push buttons, equipment, fittings, bus bars, cable boxes, cable glands etc. and all the necessary internal connections/wiring as required and as indicated on relevant drawings. Components necessary for the

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	proper and complete functioning of the Panels but not indicated on the drawings shall be supplied and installed on the Panels.
	All parts of the Panels carrying current including the components, connections, joints and instruments shall be capable of carrying their specified rated current continuously, without temperature rise exceeding the acceptable values of the relevant specifications at the part of the Panels.
	All units of the same rating and specifications shall be fully interchangeable.
	<b><u>COMPONENTS</u></b>
	GENERAL:
	<p>The type, size and rating of the components shall be as indicated on the relevant drawings.</p> <p>While selection of the capacity of the components resulting from the prevailing conditions like ambient temperature shall be allowed for. The thermal and magnetic trip rating shall be compensated for the ambient temperature.</p> <p>The ratings indicated on the drawing are ratings anticipated at prevailing site conditions.</p>
	MINIATURE CIRCUIT BREAKERS:
	Miniature Circuit breakers shall be current limiting type conformed with British standard BS: 3871 (Part I) 1965 and IS: 8825. The housing of MCBs shall be heat resistant and having high impact strength. The fault current of MCBs shall not be less than 9000 A at 230 V. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical 'ON' and 'OFF' indications.
	The circuit breaker dollies shall be of the trip free pattern to prevent closing the breaker on a faulty circuit.
	The MCB contacts shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCBs shall be provided with magnetic fluid plunger release for over current and short circuit protection. The overload or short circuit device shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCBs shall be tested and certified as per Indian Standards, prior to installation.
	<b><u>FUSE:</u></b>
	Fuses shall be of high rupturing capacity (HRC) fuse links and shall be in accordance with IS: 2000-1962 and having high rupturing capacity of not less than 35 MVA at 415 V. The back-up fuse rating for each motor/equipment shall be so chosen that the fuse does not operate on starting of motors/equipment. HRC fuses shall be of the make as specified in Make of Material.
	<b><u>AIR CIRCUIT BREAKER:</u></b>

	<p><b>Construction:</b></p> <p>The ACBs shall have following features:</p> <ol style="list-style-type: none"> <li>1. Motorised with 230 V A.C. motor.</li> <li>2. 230 V A.C closing and shunt trip coil</li> <li>3. Draw out type with "service", "test", "isolated" and "maintenance" position.</li> <li>4. Safety shutter of Fibre glass/polycarbonate sheet of 2mm thickness shall be provided</li> <li>5. Mechanically trip free plus anti-pumping feature is to be provided.</li> <li>6. Electrical trip free plus anti pumping shall be provided with relay ONLY and not by contactors.</li> <li>7. Electrical/Mechanical operation counter shall be provided.</li> <li>8. Door interlock with defeat features to be provided.</li> <li>9. ACB shall be lockable in isolation position.</li> <li><b>10. ACB should have inbuild ethernet port with web pages for Communication on EMS.</b></li> <li><b>11. ACB should have complementary mobile APP for Accessing breaker information.</b></li> <li><b>12. ACB should have self-diagnostic features like Contact wear &amp; Tear, coils connection, CT connection, spring charging Motor health, 50 trip history, Event with date and time stamping, Also should have facility of Current and voltage % THD.</b></li> </ol>
	<p><b>Release:</b></p> <ol style="list-style-type: none"> <li>1. Microprocessor based release where ever specified in SLD</li> <li>2. Short circuit, overload and earth fault protection shall be provided.</li> <li>3. Release should have facility of Inbuild Bluetooth for communication</li> </ol>
	<p><b>ACB Performance:</b></p> <ol style="list-style-type: none"> <li>1. ACB performance inside panels at ambient 50 Degree.</li> <li>2. Short circuit value 65KA for 3 sec. rating for ICW rating as per specified in SLD.</li> </ol>
	<p><b>Communication Architecture of HT &amp; LT panels is attached.</b></p>



The contractors shall meet with the requirements of IS: 2959 and BS: 775.

The contractors shall have minimum making and breaking capacity in accordance with utilisation category AC3 and shall be suitable for minimum Class II intermittent duty.

If the contractor forms part of a distribution board then a separate enclosure is not required, but the installation of the contractor shall be such that it is not possible to make an accidental contact with live parts.

**CURRENT TRANSFORMER:**

Where ammeters are called for C.T.s shall be provided for current measuring. Each phase shall be provided with separate current transformer of accuracy Class I and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with IS: 2705 - 1964 as amended up to date.

**PUSH BUTTONS:**

The push button unit shall comprise of the contact element, a fixing holder, and a push button actuator. The push button shall be momentary contact type. The contacts shall be of silver alloy and rated at 10 Amps. continuous current rating. The actuator shall of standard type and colour as per its usage for ON, OFF and TRIP.

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<b><u>INDICATING LAMPS:</u></b>
	Indicating lamps shall be transformer operated low voltage rated and shall be supplied complete with translucent covers to diffuse the lamp light.  Colour shade for the indicating lamps shall be as below – the LED shall be 22.5 mm and self-coloured:  <div>ON indicating lamp : Red</div> <div>OFF indicating lamp : Green</div> <div>TRIP indicating lamp : Amber</div> <div>PHASE indicating lamp : Red, Yellow, and Blue</div>
	<b><u>DIGITAL MULTI FUNCTION METER:</u></b>
	The load manager shall be digital type with RS485 port. It should measure KW, KVA, KVAR, V, I, PF etc. Kindly refer SLD and above metering in 6.0 for metering selection.
5.0	<b><u>DRAWING &amp; INFORMATION</u></b>
	Prior to fabrication of the Panels the supplier/contractor shall submit for consultant’s approval the shop/vendor drawing consisting of G.A. drawing, sectional elevation, single line diagram, bill of material etc. and design calculations indicating type, size, short circuiting rating of all the electrical components used, busbar size, internal wiring size, Panels dimension, colour, mounting details etc.. The contractor shall submit manufacturer’s catalogues of the electrical components installed in the Panels.
6.0	<b><u>INSPECTION &amp; TESTING</u></b>
	At all reasonable times during production and prior to transport of the Panels to site, the supplier/contractor shall arrange and provide all the facilities at their plant for inspection.
	Testing of Panels shall be carried out at factory and at site as specified in Indian standards in the presence of consultant. The test results shall be recorded on a prescribed form. The test certificate for the test carried out at factory and at site shall be submitted in duplicate to the consultant for approvals.
7.0	<b><u>METHOD OF MEASUREMENT</u></b>
	All the items will be measured as mentioned in Bill of quantity.
8.0	<b><u>TRANSPORT, DELIVERY &amp; STORAGE</u></b>
	The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of site or site store. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

	All the items will be measured as mentioned in Bill of quantity.		
<b>9.0</b>	<b><u>GUARANTEE &amp; WARRENTY</u></b>		
	The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier.		
<b>10.0</b>	<b><u>SPARES</u></b>		
	The bidder shall quote for minimum spares required for two years safe operation of transformer along with the offer separately.		
<b>11.0</b>	<b><u>DATA SHEET</u></b>		
	<b>SR. NO</b>	<b>PARTICULARS</b>	<b>DESCRIPTION</b>
	1.0	Site Condition	
	1.1	Type	Indoor
	1.2	Mounting	Floor, Indoor
	1.3	Ambient Temperature	50° C.
	1.4	Atmosphere	Corrosive, Humid & Dusty
	2.0	OPERATIVE CONDITION	
	2.1	Voltage	415 V $\pm$ 10 %
	2.2	No. Of	3
	2.3	Phase	3 $\phi$ , 4 WIRE
	2.4	System	50 HZ, + 3 % / - 6 %.
	2.5	Frequency	18 MVA
	2.6	Fault Level	As per SLD
		Fault Current	
	3.0	CONTROL SYSTEM	
	3.1	Voltage	230 V A.C.
		For	230 V A.C.
		Indication	230 V A.C.
	3.2	For Metering	230 V A.C. only
		For	
	3.3	Protection	2.5 MM <sup>2</sup> FRLS Cu. Wire
		Control Supply Through Control Transformer	4.0 MM <sup>2</sup> FRLS cu. Wire for CT ckt.
		Control Wiring	

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

	4.0	BUSBAR	
	4	Phase Bus bar	Aluminium
	A.	Material	SMC/DMC
	B.	Support	Epoxy Moulded ( Resin )
	C.	Insulation	Fibre Glass / Poly Carbonate Of Minimum 1.5 Mm
	D.	Insulating Barriers	Thick And To Be Of Fr4 Class
	E.	Current Density	1.0 Amp. / mm <sup>2</sup>
	4.2	Neutral Bus bar Material	Aluminium
	4.3	Earth Bus bar Material	GI
	5.0	Source changeover System	Not Required
	6.0	PAINTING	
	6.1	Baked At 310°C. With Powder coating. Type Of primer Type Of Paint Shade Exterior Interior Degree Of Protection Max. Temperature Rise Inside The Panel (°C.) Exterior Interior Degree Of Protection Max. Temperature Rise Inside The Panel (°C.)	EPOXY PRIMER PU Shall be confirmed with client IP 51 Shall be confirmed with 35 ° C. above ambient
		Control wiring Wire sizing	3c x 4.0 sq mm as per specified. 3 C x 2.5 mm <sup>2</sup> / 3 C x 1.5 mm <sup>2</sup> / 4 C x 1.5 mm <sup>2</sup>
		Hardware (Zinc Plated)	YES
		SPACE HEATER	230 V AC with thermostat control
		Pocket For Drawing at door	Yes
		Illumination and switched power plug	YES

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

Energy and Power Management Software Specification (EMS)	
<b>Software - General:</b>	
1. Furnish a dedicated, edge control, software platform (The Software Platform) that is purpose-built to be the operational interface for an Energy and Power Management System (EPMS) whose primary purpose is to support the provision and management of safe, reliable and efficient power within buildings and facilities. The Software Platform shall have specialized data acquisition, visualization, analysis and reporting tools specifically designed for Power Management applications such as:	
a. Electrical Distribution System Monitoring and Alarming.	
b. Electrical System Capacity Management.	
c. Power Quality Monitoring and Compliance.	
d. Multi Source Management.	
e. Continuous Electrical Thermal Monitoring.	
f. Breaker Setting Monitoring.	
g. Backup Power Testing.	
h. Power Events Analysis.	
i. Energy Usage Analysis and Energy Benchmarking.	
j. Utility Bill Verification and Cost Allocation.	
k. Energy Performance Analysis and Verification.	
2. The Software Platform shall natively support (no additional installation or configuration of the software required) at least 100 devices specifically designed for power distribution and power quality monitoring including: programmable power analyzers, power meters, branch and multi-circuit meters, smart panels with communicating circuit breakers, protection relays, uninterruptable power supplies, active harmonic filters, capacitor bank controllers, electrical distribution thermal sensors.	
a. All registers shall be pre-mapped to standard measurement names – no additional register mapping required.	
b. All native device types will come with a comprehensive set of a factory device graphical screens – no additional graphics creation or installation required.	
c. All native device types have been factory-tested and proven to perform.	
3. The Software Platform's web applications shall be simultaneously accessible from their unique web addresses so that they may be embedded in other web-based software environments.	
4. The functionality of the Software Platform shall be extensible whereby additional capabilities may be added via software license activation codes without the need to install additional software modules or add-ons.	
5. The Software Platform shall be certified as part of an Energy Data Management System	



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

according to the sections of the following ISO standards:
a. ISO 50001
i. Energy review
ii. Energy baseline
iii. Energy performance indicators
iv. Monitoring, measurement, and analysis
v. Input to management review
b. ISO 50002
i. Data collection
ii. Measurement plan
iii. Analysis
iv. Energy audit reporting
c. ISO 50006
i. Obtain relevant energy performance information from the energy review
ii. Identify energy performance indicators
6. The Software Platform shall be certified to comply with cybersecurity standard IEC62443 at the component level: IEC62443-4-1 and IEC62443-4-2 (SL1).
7. The Software Platform shall be designed to streamline the process of checking and maintaining EN50160 and IEEE 519 Power Quality compliance.
8. The Software Platform shall natively support the vendor's continuous electrical thermal monitoring system with the ability to detect abnormal bus bar or cable temperatures due to loose or faulty connections and to prevent equipment damage and fire.
9. The Software Platform shall be designed to integrate and embed within the vendor's Building Management System (BMS) software platform to provide Energy and Power Management applications within the context of the BMS environment.
<b>Software - Real Time Monitoring:</b>
1. The Software Platform shall support Auto Network Diagram Creation whereby a comprehensive set of linked hierarchical graphical diagrams is automatically created for all directly connected devices in the power monitoring network.
2. The Software Platform shall support advanced power quality meters with onboard High Speed Power Analysis with Disturbance Direction Detection (DDD) capabilities and come equipped with a built-in set of real-time graphical indicators for use in electrical one-line diagrams that indicate:
a. The type of Power Quality Disturbance (sag, swell, transient).
b. The direction of Power Quality Disturbance relative to the compliant DDD device (upstream, downstream).

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

3. The Software Platform shall provide real-time indication of the aggregated demand being measured by one or more devices in a predefined zone. The application shall allow:
a. The demand for the zone to be expressed using either Kilowatts or normalized Kilowatts/Area.
b. Visual indication of how the present demand for a zone compares with four (4) configurable limits / targets using a color scale.
c. Configurable limits shall be further configurable to allow for the use of different values during an On-Peak period compared to an Off-Peak period.
4. The Software Platform shall allow web client users to quickly and easily create interactive dashboard visualization of any real-time measurements that:
a. Display tabular and trend line views to compare device readings from multiple devices in the power monitoring network including power meters, circuit breakers, protection relays, uninterruptable power supplies, automatic transfer switches and generators.
b. Permit users to create, modify, view and share views directly from the web client browser without the need for a separate software application.
c. Support both physical and virtual devices defined in the system.
d. Support exporting real time data into Excel formats directly from the web client browser environment.
<b>Software – Alarm and Event Analysis and Notification:</b>
1. The Software Platform shall be able to acquire specialized, high speed power disturbance data directly from onboard advanced power quality meters for the purpose of Power Events Analysis, including:
a. Timestamped Power Events with Disturbance Direction Detection (DDD).
b. Timestamped high speed (1/2 cycle sample rate) pre/post event RMS data.
c. Pre/post event waveform captures (Voltage and Current all phases).
2. The Software Platform shall provide a web based power events analysis application that includes but is not limited to the following features:
a. Automatic, intelligent clustering of events into alarms and multiple alarms from multiple devices into “incidents” to simplify the analysis of multiple cascading events.
b. Automatic categorization of alarms and incidents into predefined categories such as Power Quality, Power Availability, Diagnostics and Other.
c. Predefined views for events, alarms and incidents with intuitive navigation and easy to use, configurable filters based on priority, status, source and categories.
d. Ability to create private or shared event, alarm and incident views with custom filters.

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

e. Popup window with detailed information about where, what and when an alarm or incident happened, plus other relevant information including Power Quality details and a thumbnail summary view of all waveforms associated with the alarm or incident.
f. For Power Quality alarms or incidents captured by Disturbance Direction Detection (DDD) compliant devices there shall be clear graphical indication of the direction of the disturbance (upstream or downstream relative to the DDD compliant device).
3. The Software Platform shall provide a graphical timeline view of alarms and events that constitute an “incident” in the electrical distribution network. The timeline view shall:
a. Display alarms/events stacked by order of time for sequence of events analysis.
b. Display the start and end of alarms/events with color-coded dots.
c. Indicate the direction of a Power Disturbance and if there are captured waveforms associated with the incident.
d. Have a configurable analysis window with a color-coded time slider that uses color to indicate areas in the timeline where there are greater numbers of alarms.
e. Be able to display pre- and post-event high speed RMS data coming from supported power quality meters.
4. The Software Platform shall include a web-based Smart Waveform Analyzer interface with the following capabilities:
a. Toggle on/off Voltage/Current channels.
b. RMS calculation, zoom, pan, export to CSV.
c. Interactive phasor and harmonic (voltage and current) diagrams.
d. Allow multiple waveforms to be compared to each other.
5. The Software Platform shall include an alarm annunciator to display the total number of unacknowledged alarms with a breakdown of how many are high, medium and low priority and shall allow easy navigation to the alarm viewer with a single click.
6. The Software Platform shall provide the ability to send email notifications based on recent changes to the system which will be used to formulate notification types including:
a. Communication Loss Notification – sent when the Software Platform loses communication with selected devices.
b. Alarm Summary Notification – sent regularly to indicate changes in the average amount of high, medium, and low priority alarms.
c. Power Quality Event Notification – sent regularly to indicate changes in the average amount, duration, and magnitude of Sag, Swell and Transient power disturbances.
7. The Software Platform shall have a web-based Alarm Configuration interface to allow end users to create smart alarms with the following capabilities:
a. Realtime Analog and Digital Setpoints with options for time delays and custom alarm

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

labels.
b. Smart Over/Under Setpoints designed specifically for energy (WAGES) and power alarms based on historical average, standard deviation or maximum with options for time ranges, aggregation periods, multipliers and ability to compare specific time periods (Same Hour of Day and/or Same Day of Week).
c. Communication Loss alarms with options for sensitivity and custom alarm labels.
d. Schedules interface for end users to configure when smart software alarms are active or not.
<b>Software – Data Analytics and Visualization:</b>
1. The Software Platform shall include an interactive, web-based Dashboard application that provides auto-updating dashboard views that may contain not only energy and power data but water, air, gas, electric, and steam (WAGES), historical data trends, power quality performance data, images, and content from any accessible URL address.
2. Users shall be able to create, modify, view, and share their dashboards (including graphics, labels, scaling, measurements, date ranges, etc.) using only a browser and without the need for a separate software application to design, create, modify or publish dashboards.
3. The Software Platform shall support kiosk slideshow displays by assigning individual dashboards to slideshows to run in unattended mode, scrolling through designated dashboards at a configurable time interval.
a. Any number of kiosk slideshow displays may be created and configured to run independently on any computer using a browser.
4. The Dashboard application shall provide a library of standard graphical objects (gadgets) including Bar, Pie, Trend, Real Time and Web Portal.
5. The Dashboard application shall provide a library of specialized energy usage graphical objects (gadgets) including Period Over Period Comparison, Pareto Charts, Heat Map / Carpet Plot and Sankey Diagrams.
6. The Dashboard application shall provide a library of specialized Power Quality graphical objects (gadgets) including PQ Downtime Impact, PQ Rating, PQ Incident Breakdown and Location.
7. The Software Platform shall provide an interactive, web-enabled Reports application that allows users to generate, modify, save and manage reports based on pre-formatted report templates (up to 64 templates) that are designed to support the following:
a. Energy Cost Allocation and Bill Verification.
b. Energy Usage, Modeling and Performance Verification.
c. Power Quality Performance and Compliance (EN50160 and IEEE 519).
d. Electrical Equipment Operation and Performance (Breakers, UPSs, Generators).
8. The reporting tool shall support automatic distribution (via email or shared folder) on a schedule basis or based on event or manual export using the following output formats: .csv,

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

.xlsx, .pdf, .tiff, .html, .xml.
<b>Software – Technical Infrastructure:</b>
1. The Software Platform shall be able to be installed on a physical computer or virtual machine and shall support a variety of Windows operating systems including Server and non-Server class Windows operating systems.
2. The Software Platform shall support a variety of SQL Server Editions including Enterprise, Standard and Express Editions.
3. The Software Platform shall only require SQL Server Database Engine Services and Basic Management Tools and not require the installation of any other additional SQL components such as Analysis Services or Reporting Services.
4. The Software Platform shall support the following cybersecurity features:
a. Encrypt the transmission of data between the Software Platform Server and its Web Clients using Transport Layer Security (TLS) version 1.2.
b. Establish secure authentication between the Software Platform Server and its Web Clients using Certification Authority (CA) certificates.
c. Encryption and hashing of system credentials using AES256 and SHA-512 respectively.
d. Capable of installing into a Federal Information Processing Standard (FIPS) compliant environment.
e. Application Whitelisting.
5. The Software platform shall support the integration of Windows Active Directory for users and groups from across multiple domains to facilitate the following:
a. Login to the Software Platform using Windows credentials.
b. Enforce password policies via Windows (complexity and expiration).
c. Role-Based Access Control (RBAC).
6. The Software Platform shall intelligently and automatically acquire data from devices, including onboard events, trends and waveforms from natively-supported device types:
a. Without any need for software configuration or data upload scheduling.
b. Onboard, high resolution timestamps (1ms) shall be retrieved without degradation or modification even for devices that support clock synchronization via GPS, IRIG-B, NTP or PTP (Precision Time Protocol).
7. The Software Platform shall support logical device definitions based on inputs/outputs or channels on devices that represent a downstream device with the following features:
a. Software user interface for device and measurement mapping.
b. Bulk-import capability to create large numbers of logical devices without manual single-device configuration.

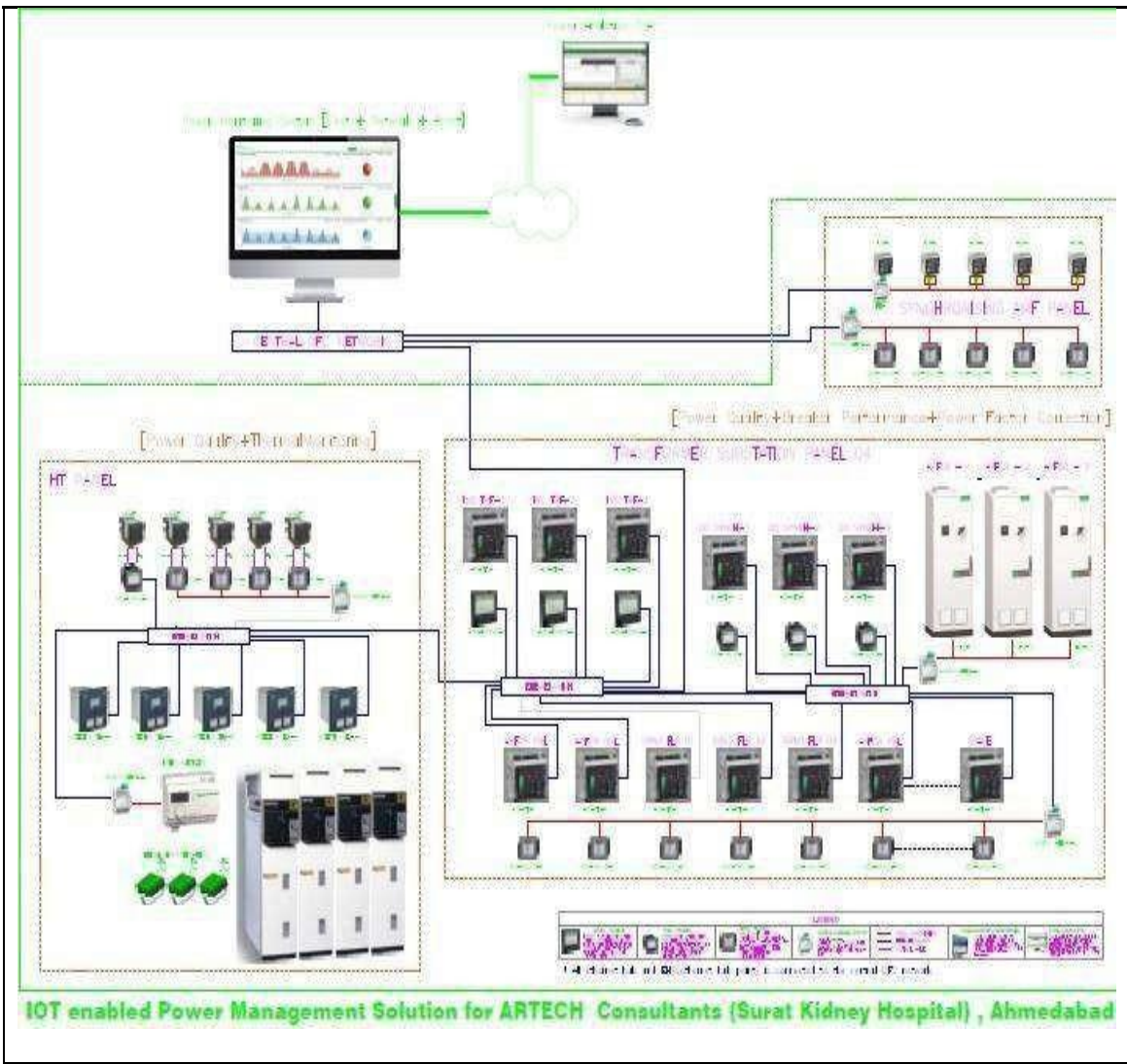
## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

8. The Software Platform shall support real-time and historical data aggregation within defined hierarchy views (e.g. Tenants/Racks/Circuits, PDUs/RPPs/Panels, Buildings/Floors/Rooms, or any user defined view) with the following capabilities:
a. Web-based, end user interface.
b. Automatic and intelligent data aggregation across all nodes in the hierarchy for data visualization in Dashboards, Trends and Reports.
c. Creation of virtual devices to enable applications such as net metering, common area allocation and apportionment.
d. Update node names and associated time ranges in the hierarchy to properly reflect and accurately report on facility changes (e.g. tenant move in – move out).
e. Bulk-import capability to create and edit large hierarchies without manual per-device setup.
9. The Software Platform shall support OPC DA Server 2.01 with the following capabilities:
a. Provide default OPC Server tag mappings for all natively supported device types without the need to select, configure, or program the mapping of device registers to OPC tags.
b. Provide a flexible means to add or change OPC mappings and shall support the ability to add custom measurements.
10. The Software Platform shall support OPC DA Client 2.01 and come with a built in OPC Test Client.
11. The Software Platform shall support device-level Modbus integration with the following capabilities:
a. Modbus master to read/write registers in Modbus devices for monitoring and control applications.
b. Support for at least 70 Modbus data formats including 16bit Signed/Unsigned Integers (S16-21, S16-12, U16-21, U16-12, S16-1-15),
12. The Software Platform shall have a single, end user software application specifically designed for integrating Modbus and OPC device types and shall have the following capabilities:
a. Simple creation and management of Modbus and OPC device definitions (device drivers) and association of device graphic template screens.
b. Pre-defined, default measurement system (Common Data Model) for consistent mapping of Modbus registers and OPC tags to standard measurements.
13. The Software Platform shall support Web Services interoperability with the following capabilities:
a. Web Services Server for sharing real-time, historical (i.e. timestamped trend data), and alarm data (i.e. timestamped event strings) from the Software Platform to other Web Services Client applications.

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

b. User interface for Web Services configuration and mapping.
c. Provide the ability to acknowledge alarms by authenticated and authorized clients.
14. The Software Platform shall have an Extract, Transform, and Load (ETL) engine for exchanging data between files, databases and systems with the following capabilities:
a. User Interface for specifying connection information, data formats, measurement mappings and schedules.
b. Support for importing data from .csv and .xml data files, Wonderware Historian databases and other 3rd party databases via OledB connections.
15. The Software Platform shall support system-wide programs using a graphical, object-oriented application engine capable of logic and arithmetic functions, database queries, XML data import, complex logic-based alarming and data logging, email and text notifications.
16. The Software Platform shall remain online (including communications, logging, and alarming) and not require an operator to take the system offline during all system administration functions such as adding, modifying, or removing devices in the system; creating, modifying, or removing graphical diagrams, dashboards, tables, and reports; creating, modifying, or removing application logic programs in the application logic engine.
17. The Software Platform shall support offline software configuration management for efficient system deployments and upgrades with a dedicated user interface for creating, copying and deploying software configuration projects.
18. The Software Platform shall support internationalization and regional settings.
19. The Software Platform shall support the ability to change its default language at any time directly from the web client without the need for any additional installation or advanced software configuration.
20. All bidders should consider complete scope of Energy Management system with all the accessories like Software, PC, SQL License, with UPS with one Web view license, Lan cable, Communication Cable, Ethernet Gateway with supply and commissioning of complete project.
21. <b>PC Server specification</b> should be as follows:
· Server PC (Intel Xeon E3-1220v5/ 16GB RAM / 1TB SAS
· Monitor: 21.5" TFT LED Back Lit Monitor
· Windows Server 2016 Std
· Ms-Office 2016
· Quick Heal Antivirus for Server PCs for 3 Years
22. SQL Server : Microsoft SQL Database standard version 2014/16/17.
23. Communication Architecture: All Contactors should provide complete cost of EMS with all devices as per below Architecture.

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS





12.0	<b><u>TECHNICAL SPECIFICATIONS FOR D.G SET</u></b>																																										
1.0	<b><u>SCOPE OF WORK</u></b>																																										
1.1	<p>This specification covers the design, construction features, manufacture, supply and performance of emergency diesel generator. The scope includes supply, installation, testing and commissioning of D.G. set along with fuel pipeline, residence type exhaust pipe insulation and all the accessories required for trouble free operation.</p> <p>Diesel Engine driven Generator set for use in Industrial plants as per Ministry of environment and forests notifications, BEE certified, Gujrat Bye Laws, CPCB, New Delhi 11/12/13 &amp; amendment dated 31/3/14.</p>																																										
2.0	<b><u>CODES &amp; STANDARDS</u></b>																																										
2.1	<p>The design, material, construction, manufacture, inspection, testing and performance of DG set shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards and codes of practice.</p>																																										
	<p>The DG set shall meet the requirements of the following standards and rules</p> <table><tr><th>Sr.</th><th>Item</th><th>Relevant IS/BS</th><th>Relevant IEC/ISO</th></tr><tr><td>1</td><td>Designation for type of construction and mounting arrangement of rotating electrical machines.</td><td>IS: 2253</td><td></td></tr><tr><td>2</td><td>Degree of protection providing by enclosures of rotating electrical machinery.</td><td>IS: 4691</td><td>IEC 60529</td></tr><tr><td>3</td><td>Terminal marking of rotating electrical machines.</td><td>IS: 4728</td><td></td></tr><tr><td>4</td><td>Guide for testing 3 Phase Synchronous Machines.</td><td>IS: 7132</td><td></td></tr><tr><td>5</td><td>Turbine type generators.</td><td>IS: 5422</td><td></td></tr><tr><td>6</td><td>Methods of determination of efficiency of rotating electrical machines.</td><td>IS: 4889</td><td></td></tr><tr><td>7</td><td>Insulating materials for Electric machinery and apparatus in relation to their thermal stability service, classification.</td><td>IS: 1271</td><td></td></tr><tr><td>8</td><td>Specification for rotating electrical machines</td><td>IS: 4722/BS 5000</td><td></td></tr><tr><td>9</td><td>Performance requirements for constant speed compression ignition (diesel) engine</td><td>IS 10002</td><td></td></tr></table>			Sr.	Item	Relevant IS/BS	Relevant IEC/ISO	1	Designation for type of construction and mounting arrangement of rotating electrical machines.	IS: 2253		2	Degree of protection providing by enclosures of rotating electrical machinery.	IS: 4691	IEC 60529	3	Terminal marking of rotating electrical machines.	IS: 4728		4	Guide for testing 3 Phase Synchronous Machines.	IS: 7132		5	Turbine type generators.	IS: 5422		6	Methods of determination of efficiency of rotating electrical machines.	IS: 4889		7	Insulating materials for Electric machinery and apparatus in relation to their thermal stability service, classification.	IS: 1271		8	Specification for rotating electrical machines	IS: 4722/BS 5000		9	Performance requirements for constant speed compression ignition (diesel) engine	IS 10002	
Sr.	Item	Relevant IS/BS	Relevant IEC/ISO																																								
1	Designation for type of construction and mounting arrangement of rotating electrical machines.	IS: 2253																																									
2	Degree of protection providing by enclosures of rotating electrical machinery.	IS: 4691	IEC 60529																																								
3	Terminal marking of rotating electrical machines.	IS: 4728																																									
4	Guide for testing 3 Phase Synchronous Machines.	IS: 7132																																									
5	Turbine type generators.	IS: 5422																																									
6	Methods of determination of efficiency of rotating electrical machines.	IS: 4889																																									
7	Insulating materials for Electric machinery and apparatus in relation to their thermal stability service, classification.	IS: 1271																																									
8	Specification for rotating electrical machines	IS: 4722/BS 5000																																									
9	Performance requirements for constant speed compression ignition (diesel) engine	IS 10002																																									

# TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

			for general purposes.			
		10	Reciprocating internal combustion engines.	IS 7451		
		11	Method of tests for IC engines	IS 10000		
		12	Rotating electrical machines (All parts).		IEC 34	
		13	Temperature rise measurement of rotating electrical machines.	IS 12082		
		14	Mechanical vibration of rotating electrical machines.	IS 12075		
		15	Permissible limits of noise levels for rotating electrical	IS 12065		
		16	Measurement of vibrations	IS 4729		
		17	Methods of determination of efficiency of rotating electrical machines.	IS 4889		
		18	Mechanical vibration – balance quality requirements of rotor in a constant (rigid) state – specification and verification of balance tolerances.		ISO 1940	
		19	Specifications for DG Set.		ISO 8528	
		20	Indian Electricity Act and Indian Electricity Rules.			
		21	Norms of Local Authority and Latest Central Pollution Control Board.			
<b>3.0</b>	<b><u>DESIGN BASIS</u></b>					
	All the equipment and components provided in the DG set with accessories shall be suitably designed for installation and satisfactory operation as specified below.					
		<b>Electrical system data:</b>				
		<b>Power supply for Equipment</b>				
		Voltage 433 V ± 10 %		<b>Frequency</b> 50 Hz ± 3 %		
		<b>Permissible combined voltage &amp; frequency variation</b>	± 6 %	<b>System design faults level (Symmetrical)</b>	30 kA for 1 sec. max.	

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

		<b>System earthing</b> LV side neutral solidly earthed	<b>Wiring</b> 3 phase, 4 wire on 433V system
		<b>Maximum operating temperature</b>	95 DEGREE C
		<b>Auxiliary power supply :</b>	
		<b>Power supply</b>	240V AC, 1-Ph, 50Hz
		<b>Control Supply</b>	-----
		<b>Space heater power supply</b>	240V AC, 1-Ph, 50Hz
		<b>Illumination power supply</b>	240V AC, 1-Ph, 50Hz
		<b>Plug-socket power supply</b>	240V AC, 1-Ph, 50Hz
<b>4.0</b>	<b>SITE CONDITIONS</b>		
		LOCATION	RAJPIPLA , GUJARAT
		ALTITUDE	UPTO 1000 MSL
		AMBIENT TEMPERATURE MAXIMUM	50 DEGREE C
		MAX. RELATIVE HUMIDITY	95%
<b>5.0</b>	<b><u>TECHNICAL REQUIREMENTS</u></b>		
<b>5.1</b>	<b><u>GENERAL CONSTRUCTIONAL FEATURES</u></b>  <p>The diesel engine offered shall be of the regular production models of the manufacturer for industrial applications and already type tested either at the manufacturer's works or outside. The type test report shall be furnished to the purchaser for his review if so desired.</p> <p>In case the proposed engine model has not been type tested, vendor shall furnish with the offer, a reference list of its existing industrial installation and at least three of these engines, should have completed, 5000 hours of running at site.</p> <p>Unless otherwise specified in the equipment data sheets, the diesel engine shall be provided with class A1 governing as per the latest edition of B.S. 5514/ISO 3046 (Reciprocating IS engines - Performance)</p> <p>The "Cyclic irregularity" of the diesel engine for direct coupling to an electric generator, "angular deviation of A.C. generators" given by diesel engine for parallel operation, and the "engine governor deviation of A.C. generators" given by diesel engine for parallel operation, and the "engine governor speed droop characteristics", shall be restricted to the values specified under the latest edition of B.S. 5514.</p> <p>The vendor shall be responsible for carrying out torsional analysis of the dynamic system as specified in</p>		

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

5.2	<p>the latest edition of British Standard-5514. The results in the form of a report shall be submitted to the purchaser for scrutiny and reference, if desired.</p> <p>Vendor shall provide the flexible exhaust connections to connect the engine exhaust to the exhaust piping. The required size of the exhaust piping should be clearly specified by the vendor.</p> <p>The common base plate for mounting the diesel engine and the driven equipment as well as the flexible coupling shall be supplied by the vendor.</p> <p>Engine shall be capable of delivering specified prime mover rating at variable loads of p.f 0.8 lag with 10% overload in excess of specified output for 1 hr. every 12 hrs. upto 50 degree C</p> <p>Vendor shall indicate in the bid, the IS Noise Level rating of the diesel engine with the offered exhaust silencer, which should not exceed more than <b>75 db at 1 Mtr.</b> Distance.</p> <p>The height of stack and the DG set shall comply CPCB-2 and latest amendments</p> <p><b><u>ENGINE STARTING</u></b></p> <p>Diesel engines shall be capable of starting without the use of cold starting aids so long the ambient temperature at the site is not below 4° c.</p> <p>Where the diesel engine is specified / offered with battery starting arrangement, the starter motor shall be capable of starting the engine without having to disengage the driven machine with the help of a clutch. Where the diesel engine is equipped with a dual starter the synchronizing switch and the corresponding wiring / connection with the starter motor shall be provided by the vendor.</p> <p>In case of diesel engines driving the engine, mounted battery charging alternator, the Vendor shall also provide Battery, automatic Electronics float &amp; boost type battery charger suitable for taking power from supply authority's power source and mounted on a free-standing type of a panel.</p> <p>The battery charger as specified in the equipment data sheet, shall be capable of delivering a current equal to 100% of the 20 hours discharge rate of the battery and also equipped with charging rate selector device.</p> <p>As specified in the data sheets, the diesel engine is required to start / stop automatically, the vendor shall provide the necessary controls (automatic - cum -manual) in the engine panel and the interconnecting wiring and piping from the panel to the engine and starting equipment. A pilot lamp shall be provided in the line side of the starting equipment circuit to indicate that the controller is in the automatic position. In the event the engine does not start after three attempts have been made, the controller shall stop all further cranking and operate the audio-visual alarm. Shaft driven lubrication system is acceptable, alternatively D.C. motor driven lubrication pump with timer suitably interlocked with the starting system is acceptable.</p>
5.3	<p><b><u>ENGINE COOLING</u></b></p> <p>Vendor shall supply radiator cooled &amp; engine jacket water used, shall be mixed with additive as per recommendation of manufacture. The radiator shall preferably have separate sections for jacket cooling system and turbocharger air cooling system. It should be with engine mounted water pumps, thermostats, coolant, self-content piping.</p>
5.4	<p><b><u>ENGINE FUEL SYSTEM</u></b></p>

<p><b>5.5</b></p>	<p>The daily service fuel tank capacity upto 990 liters shall be equipped with shielded level gauge, strainer and a hand hole of not less than 150mm diameter, besides the required fuel connections and a drain plug. One tank of suitable capacity to be provided.</p> <p>The inside surfaces of the fuel tank and the float tank shall be coated with Enamel Red or Black of I.C.I. or its equivalent and the outside surface to be given two coats of the oil resistant primer paint. The fuel tank shall be hydrostatically tested at a pressure not less than 0.35 Kg./Cm.<sup>2</sup></p> <p>Fuel oil transfer pump to transfer oil from barrels to day tank shall also be provided.</p> <p>All piping, valves, fittings and supports inside D.G. house shall be part of supply.</p> <ul style="list-style-type: none"> <li>□ PT fuel pump</li> <li>□ STC Injectors</li> <li>□ Fuel filters</li> <li>□ Self-contained piping</li> </ul>
<p><b>5.6</b></p>	<p><b><u>INSPECTION &amp; TESTING:</u></b></p> <p>The vendor shall have the responsibility of providing purchaser's representative with all requisite facilities / equipment for carrying out satisfactory testing.</p> <p>The diesel engines shall be tested in the presence of purchaser's representative accordance with latest edition of B.S. 5514 or any other equipment standard as agreed to with the purchaser before the finalization of order.</p> <p>The routine load and fuel consumption test shall be of the 3 hours. If extra hours testing required then client shall let the vendor to know.</p> <p>Unless otherwise specified, 10% overload provision shall be kept while setting the fuel limit for the site running.</p> <p>The engine control panel/s after assembly and wiring, shall be functionally tested in the presence of the client's / consultant's representative.</p> <p><b><u>TESTS:</u></b></p> <p>Equipment shall be tested to conform to the appropriate standards and the following tests shall be conducted in the presence of purchaser's:</p> <p>Functional tests, continuity tests and high voltage test on control panel to establish the performance called for in the specification.</p> <p>Power frequency voltage test on switch gear and mechanical / electrical operational check. Routine tests for alternator as per IS: 4722/BS 5000 (Rotating Electrical Machines and the relevant standards)</p> <p>Over speed test for machines safety tripping.</p> <p>Transient response tests for sudden application and rejection of loads of for G2 class as per IS 8258. Block loading capacity shall be upto 60% of DG set capacity in a single step.</p>

	<p>On Site test :</p> <ul style="list-style-type: none"> <li>• Phase sequence test.</li> <li>• Vibration test.</li> <li>• Dimensional and alignment test.</li> <li>• Wave from test.</li> <li>• Load test at 25, 50, 75, 100% Loading.</li> <li>• Governor test</li> <li>• Generator performance test</li> </ul> <p>Factory test :</p> <ul style="list-style-type: none"> <li>• Noise level test.</li> <li>• Wave from test.</li> <li>• Cold and hot starting test</li> <li>• Test in trips and alarms</li> <li>• Overloading test - 110%</li> </ul>
<b>5.7</b>	<p><b><u>ALTERNATOR</u></b></p> <p>This specification defines the requirements of design, manufacture, testing and supply of self-excited emergency generator complete with automatic voltage regulator, control panel, isolator and other accessories as specified in the material requisition.</p> <p>Unless otherwise specified the emergency, generator shall be supplied complete with:</p> <ol style="list-style-type: none"> <li>1. Brush less excitation system completes with AVR.</li> <li>2. Electric panel including control cubicle and associated auxiliary devices, relay panel and generator breaker / isolator, battery and battery charger.</li> <li>3. Air inlet and outlet for generator cooling (inlet shall be oriented to suit total plant layout).</li> <li>4. Lifting arrangement for the machine.</li> <li>5. Foundation frame complete with foundation bolts to install along with engine on common base frame.</li> <li>6. Lub. oil system integral with the prime mover lub. oil system.</li> <li>7. Spares for commissioning.</li> <li>8. Spares for two years of operation and maintenance.</li> </ol> <p>Any other part / accessories not specifically mentioned above but considered necessary for safe and reliable operation.</p>
<b>5.8</b>	<p><b><u>DESIGN &amp; CONSTRUCTION</u></b></p> <p>The alternator shall be mounted on a common base frame together with the prime mover unless otherwise agreed. The generator shall be provided with necessary lifting hooks and two earth terminals for connection to main earth grid.</p> <p>The alternator winding shall be class "F" insulation with temperature limitation to Class "B"</p> <p>The stator windings shall be brought out to six insulated terminals in two separate terminal boxes. The</p>

	<p>alternator shall, therefore, be provided with three separate terminal boxes i.e. for the line and neutral stator connection and for control connection. The terminal box for the line terminal shall have 40 % free space and each segregated for easy cable end connection of cable size specified in datasheet. The neutral box in addition to the space for neutral earthing cable shall have sufficient room for the current transformers used for the protection of the generator. Star connection shall be formed in the neutral side of terminal box. The terminal box for control cable shall contain properly marked terminals for all internal equipments e.g. embedded temp. detectors etc. All terminals shall be stud type. The terminal boxes shall be complete with lugs and double compression type cable glands. Current transformers shall be as specified in data sheet.</p> <p>All parts and accessories shall be suitable to withstand stresses due to over speed / overload / short circuit conditions specified.</p> <p>Bearings shall be double shielded and pre-lubricated. Grease in the bearing enclosure shall provide additional lubrication to bearings as well as provide sealing against dust and moisture. On line greasing facility with excess grease expulsion system shall also be provided.</p> <p>The alternator shall be air cooled unless otherwise agreed, alternator enclosure shall be as specified in data sheet.</p> <p>The direction of rotation of the rotor of the machine shall be compatible with that of the prime mover. A clear indication of the direction of rotation shall be given on either end of the machine.</p> <p>Field winding shall have class "H" insulation with excellent electrical and mechanical properties. The field winding shall be capable of operating at a field voltage with Excitation capacity <math>E_{max} / E_n = 1.6</math> for at least two minute to meet improved stability requirements.</p> <p>A rating plate of S.S material shall be fixed on the generator frame and shall give the following information:</p> <ol style="list-style-type: none"> <li>1. Manufacturer's name.</li> <li>2. Serial Number, Type and frame reference</li> <li>3. Rated output in KVA &amp; KW</li> <li>4. Rated power factor, frequency and voltage</li> <li>5. Rated stator current and speed in Rev. / Min.</li> <li>6. Class of insulation</li> <li>7. Phase rotation (CW or CCW)</li> <li>8. Customer's indent no.</li> <li>9. Year of manufacture</li> <li>10. Weight of rotor and stator in Kg.</li> </ol>
<b>5.9</b>	<p><b><u>EXCITATION SYSTEM</u></b></p> <p>The generator shall be provided with brush less type solid state excitation system.</p> <p>Exciter cooling shall be IC 01</p> <p>The field of the exciter shall be either permanent magnet type or externally excited through external</p>

	<p>power, transformer and AVR. AC voltage generated in the exciter shall be rectified by the rotary rectifier assembly and feed power to the main field circuits of the generator.</p> <p>The exciter capacity shall be at least 20% more than the maximum requirement at any time.</p> <p>The exciter winding shall be insulated with class "H" insulation.</p> <p>Automatic solid state voltage shall be provided with the following features as a minimum.</p> <ol style="list-style-type: none"> <li>1. Short circuit protection.</li> <li>2. Manual voltage control switches with adjuster.</li> <li>3. Cross current compensation for parallel operation.</li> <li>4. Voltage builds up circuitry.</li> <li>5. Stator current limiter.</li> <li>6. Field current limiter</li> </ol> <p>The current and potential transformers required to feed the AVR from the generator terminal shall be adequately rated.</p>
<b>5.10</b>	<p><b><u>ACOUSTIC ENCLOSURE</u></b></p> <p>The canopy should be sound proof, weather proof &amp; environment friendly, conforming to the latest environment (protection) act 1986 (29 of 1986) of ministry of Environment and forest notification No. dated 17<sup>th</sup> May 2002 and 12<sup>th</sup> July, 2004 and second amendment of 2002 and 2004 respectively. No set shall be accepted without the CPCB2(latest as applicable for environmental clearance ) certificate of authorized agencies such as ARAI of Pune, NPL New Delhi, NSTL Visakapattanam, FCRI Palghat and NAL Bangalore.</p> <p>The canopy shall be in modular construction with the provision of assembly at site. The acoustic panels shall be fabricated in 2mm thick CRCA sheet. The finished sheet metal component shall undergo seven tank treatment process for degreasing, derusting, phosphatising etc. for longer life and should be by Polly polyester based coated inside &amp; outside. The nuts bolts and other hardware shall be Zinc coated. The door shall be provided with high quality EPDM gaskets to avoid leakage of sound. The door handles and hinges shall be Zinc plated &amp; lockable type.</p> <p>The Radiator fan of the water cooled Engine shall be used for ventilation. A pusher fan (for air cooled Engines) or in addition to Radiator fan, if required shall also be provided. The motor of this fan shall be of BSNL approved make.</p> <p>Adequate ventilation shall be provided to meet the air requirement for combustion &amp; also to expel heat to maintain temperature inside the enclosure within 7 degree Celsius above ambient at 10% overload with tripping arrangement between (50 – 60 ) degree Celsius.</p> <p>An arrangement for adequate illumination inside the enclosure shall be provided.</p> <p>Separate door with locking arrangement for easy access to D.G. set during operation &amp; maintenance should be provided.</p> <p>The enclosure shall be guaranteed for a period of 12 months from the date of completion of work against defective materials &amp; rust, welding, painting, smooth functioning of doors, inspection window etc. minor</p>



	<p>civil work is to be carried out without any extra cost.</p> <p>Small see through window for reading meters etc. made of transparent polymer sheet of thickness not less than 5mm shall be provided</p> <p>Proper sealing arrangement between radiator and radiator partition shall be provided to avoid hot air returned to the canopy.</p> <p>Fuel Tank and Control Panel shall be incorporated inside the canopy.</p> <p>Two point lifting arrangement.</p> <p>Main base frame will be of size 100mm X 50mmX 5mm MS channel welded with 3mm thick MS sheet for bolting arrangement complete as required.</p> <p><b>Acoustic enclosure with the following thickness of CRCA sheet shall also be accepted :</b></p> <p><b>(a) 1.5mm for roof and 1.2mm for door and stay</b></p> <p><b>(b) 1.5mm for roof and 1.2mm for door</b></p> <p><b>(C) 1.6mm for all</b></p> <p>Insulation on enclosure will be provided &amp; fixed of :</p> <p>Mineral rock wool Slabs of density not less than 96kg/M3 of 75mm thickness, covered with 22 gauge GI sheet having 3mm perforation fitted with strips of AL by hydraulic riveting to support the whole insulation rigidly complete as required. (OR) Polyurethane foam / PUF of minimum 26Kg / m<sup>3</sup> density acoustic foam of dark grey / black colour, fire retardant and not less than 20 mm thickness.</p> <p>The following canopy insulation material is also acceptable to BSNL</p> <p>PVC foam 1.5mm / 2mm and density of 100-110 kg / sq.m.</p> <p>Specially designed sound attenuators shall be provided to control sound at air entry &amp; exit points i/c louvers</p> <p>The canopy shall be provided with emergency stop button easily approachable from outside.</p> <p>The canopy shall be provided with following meters (visible from outside): -</p> <ul style="list-style-type: none"> <li>• Lub. Oil pressure gauge.</li> <li>• Water temperature gauge (for water cooled engines only).</li> <li>• Dial type fuel gauge with sensing arrangement.</li> </ul>
<b>6.0</b>	<b><u>INSTALLATION OF SYSTEM</u></b>
<b>6.1</b>	<b><u>ENGINE STARTING</u></b>
<b>6.1.1</b>	Diesel engines shall be capable of starting without the use of cold starting aids so long the ambient temperature at the site is not below 4°C
<b>6.1.2</b>	Where the diesel engine is specified / offered with battery starting arrangement, the starter motor shall be capable of starting the engine without having to disengage the driven machine with the help of a clutch. Where the diesel engine is equipped with a dual starter the synchronizing switch and the corresponding wiring / connection with the starter motor shall be provided by the vendor

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>6.1.3</b>	In case of diesel engines driving the engine mounted battery charging alternator, the Vendor shall also provide Battery, automatic Electronics float & boost type battery charger suitable for taking power from supply authority's power source and mounted on a free standing type of a panel.
<b>6.1.4</b>	The battery charger as specified in the equipment data sheet, shall be capable of delivering a current equal to 100% of the 20 hour discharge rate of the battery and also equipped with charging rate selector device
<b>6.1.5</b>	As specified in the data sheets, the diesel engine is required to start / stop automatically; the vendor shall provide the necessary controls (automatic - cum -manual) in the engine panel and the interconnecting wiring and piping from the panel to the engine and starting equipment. A pilot lamp shall be provided in the line side of the starting equipment circuit to indicate that the controller is in the automatic position. In the event the engine does not start after three attempts have been made, the controller shall stop all further cranking and operate the audio-visual alarm. Shaft driven lubrication system is acceptable; alternatively D.C. motor driven lubrication pump with timer suitably interlocked with the starting system is acceptable.
<b>6.2</b>	<b><u>SYSTEM OPERATION</u></b>
<b>6.2.1</b>	The emergency generator set shall normally be in an unattended area. The control system shall operate in fail safe mode and shall include all controls and protection necessary for the safe operation of the package. The generator set shall function as per one of the following schemes:  Manual start in service mode.  Manual test mode.
<b>7.0</b>	<b><u>INSPECTION &amp; TESTING</u></b>
<b>7.1</b>	The vendor shall have the responsibility of providing purchaser's representative with all requisite facilities / equipment for carrying out satisfactory testing
<b>7.2</b>	The diesel engines shall be tested in the presence of purchaser's representative accordance with latest edition of B.S. 5514 / ISO 3046 - Reciprocating IC engines performance or any other equipment standard as agreed to with the purchaser before the finalization of order.
<b>7.3</b>	The routine load and fuel consumption test shall be of the 3 hours.
<b>7.4</b>	Unless otherwise specified, 10% overload provision shall be kept while setting the fuel limit for the site running
<b>7.5</b>	The engine control panel/s after assembly and wiring, shall be functionally tested in the presence of the client's / consultant's representative
<b>7.6</b>	Functional tests, continuity tests and high voltage test on control panel to establish the performance called for in the specification

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

<b>7.7</b>	Power frequency voltage test on switch gear and mechanical / electrical operational check
<b>7.8</b>	Routine tests for alternator as per IS: 4722/BS 5000 Rotating Electrical machines.
<b>7.9</b>	Over speed test for safety tripping of machine.
<b>7.10</b>	Transient response tests for sudden application and rejection of loads of for G2 class as per IS 8258. Block loading capacity shall be upto 60% of DG set capacity in a single step.
<b>7.11</b>	Phase sequence test
<b>7.12</b>	Vibration test
<b>7.13</b>	Noise level test
<b>7.14</b>	Dimensional and alignment test
<b>7.15</b>	Wave from test
<b>7.16</b>	The owner or his authorized representative may visit the works during manufacture of equipment to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given all assistance to carry out the inspection
<b>7.17</b>	Detailed test procedure along with the facilities available at vendors works shall be furnished along with the bid Owner's representative shall be given minimum four weeks advance notice for witnessing the final testing. Test certificates including test records and performance curves etc. shall be furnished for the complete D.G., individual test certificates of engine / alternator / common panel should be submitted, only thereafter complete D.G. would be tested.
<b>8.0</b>	<p><b><u>AMF CONTROL PANEL</u></b></p> <p>Control panel shall be cubical type made of 16 gauge CRCA sheet with hinged type open able covers mounted above base frame at suitable location of E/A set and supported on both sides on base frame. Rubber pads of 6mm. thickness shall be provided between the base frame and control panel supports.</p> <p>Control panel shall be metal enclosed, free-standing, floor mounted, single front, fixed / draw-out type.</p> <p>Panel suitable for indoor installation with degree of protection minimum IP41 for indoor panel and IP 65 if outdoor installation.</p> <p>All the control panel wiring should be easily accessible and shall have sufficient working space for making connections of cables etc.</p> <p>Panels shall be provided with detachable gland plate at bottom for cable entry. For single core cables, gland plates shall be made up of non-magnetic material.</p> <p>A manual bypass switch shall be provided on the control panel for <u>total bypass of the AMF system</u>. The changeover from Mains supply to EA set supply should be possible in manual mode with AMF relay totally by passed.</p> <p>Panel operating height shall be minimum 300 mm and shall not be more than 1800 mm. Panel's overall</p>

height shall not be more than 2300 mm.

All protection relays, meters, switchgears and control components as per approved make.

Busbars shall be high conductivity electrolytic grade aluminium supported on non-hygroscopic, non-flammable insulators.

Inside control panel, all control, protection and instrument wiring shall be done with BIS approved, 660 V grade Fire Retardant type, PVC insulated Copper Conductor. Minimum conductor size shall be 2.5 sqmm for CT circuit wiring and 1.5 sqmm for control wiring.

A tinned copper earth stud of adequate dimension shall be provided. The panel shall be consisting of 3 poles/4 Poles MCB/ Breakers (with adjustable current setting) MCCB, Contactors of required rated MCB 4 pole, AC-3 duty (or) 50A, 4 pole AC-1 duty power Contactors for Main / Diesel EA set (Mechanically interlocked & electrically interlocked) with contactor coil.

The supply to the coil of the mains contactor is to be provided with the help of a static voltage regulator having wide input range from 90Volts to 300 Volts and output within the operating range of contactor coil.

The supply to the coil of the mains contactor is to be provided with the help of a static voltage regulator having wide input range from 90Volts to 300 Volts and output within the operating range of contactor coil.

Potential free contacts for extension of alarms- (6 Nos.) viz. lack of fuel, LLOP, Mains Fail, Engine Fail to start, Door opening, high cylinder / Water temp.

Microprocessor based Automatic Mains Failure Controller with following functions:

Features, Functions, Protections , Performances

- 16 character x 2 line alphanumeric LCD display with LED backlight.
- Operator interface.
- Provide a record of most recent fault conditions. Fault history stored in the control nonvolatile memory.
- Provide Alternator data like Voltage (line to line and line to neutral voltage), Current (3 ph), kVA (3 ph and total), Frequency etc.
- Provide Engine data like Starting Battery Voltage, Engine running hours, Engine Temp, Engine oil pressure etc.
- Control includes provision for Service adjustment and calibration of DG control functions like Voltage, frequency selection, Configurable input and output set up, Meter calibration.
- Engine controls.
- Power Start operates on 12/24 VDC batteries.
- Auto start mode accepts a ground signal from remote devices to automatically start the DG

set. The remote start will also wake up the control system from sleep mode.

- Engine Starting – The control system supports automatic engine starting, Primary and back up start disconnects are achieved by battery charging alternator feedback or main alternator output frequency.
- Controller provide configurable time delay of 0-300 sec to start after remote start signal and time delay of 0-600 secs prior to shut down after stop signal.
- Sleep mode increase battery life. Configurable current settings from low to minimize current draw when Gen Set is not working.
- Engine Protective Functions includes.
- Configurable alarm output.
- Emergency stop: Annunciated whenever an emergency stop signal is received by the control.
- Low Lube oil pressure warning and shutdown.
- High engine water temperature warning/ shutdown.
- Low coolant temp warning.
- Sensor failure indication.
- Low and high battery voltage warning.
- Weak battery warning.
- Fail to start shut down.
- Cranking lockout: Control will not allow the starter to engage or to crank the running engine.
- Cyclic cranking: Configurable for the number of starting cycle (1 to 7) and duration of crank and rest periods.

One GSM modem shall be provided along with necessary software for transferring the data to the base station in Excel sheet. The GSM modem shall have two inputs one each for AMF and AC controller. The data from both AMF and AC controller should be accessible at remote station.

Connections of control wiring shall be done with screw less connector strips and ferrules for identification on both ends.

1. AC and DC wiring shall be separated distinctly.
2. 1No. Multifunctional meter to indicate Voltage, Current, PF, Frequency & kWh.
3. Push buttons for stop, reset, test, and acknowledge.
4. Recess type hooter.
5. Audiovisual indication for LLOP, HCT / HWT, Over speed, Lack of fuel.
6. RYB LED indication for indicating Mains / EA Set Supply – 2 sets.

	<p>7. DC. Ammeter [0-15A], DC. Voltmeter [0-30V] of size 96mm x 96mm with selector switch for trickle /boost charging through battery charger and battery charging unit.</p> <p>8. Selector switch for Auto / Manual operation.</p> <p>Battery Charger: Automatic trickle /boost battery charger of SCR or SMPS type to charge the starting battery of DEA set. This charging shall be done through main supply for which a suitable incomer shall be provided in the panel with suitable range of ammeter and voltmeter on the DC side with protective fuses.</p> <p><b><u>NOTE:</u></b></p> <p><b>DG set and AMF manufacturer shall be same. Suitable Breaker/ MCCB required as isolation in each AMF panel.</b></p>
<b>9.0</b>	<p><b><u>EXHAUST AND AIR INTAKE SYSTEM</u></b></p> <p>The engine-generator set shall have a complete exhaust and air intake system, including air intake filter and silencer, expansion bellows, exhaust muffler etc.</p> <p>The exhaust muffler shall be mounted on the engine-generator set and shall be provided with lugs, flanges, or other items necessary for supporting the unit.</p> <p>The exhaust system includes flexible SS bellows, residential silencer &amp; exhaust piping of appropriate size, class B MS pipe clad with rock wool &amp; overall aluminium cladding for complete run. The exhaust pipe work includes necessary angle &amp; supports from ceiling to avoid any load &amp; stress on turbo charger / exhaust piping. The outdoor exhaust piping shall be supported by free standing/wall support MS structure. The tail end of exhaust pipe shall have 45 degree downward cut to avoid rain water entry into exhaust piping. The exhaust outlet should be in direction of prevailing winds &amp; should not allow exhaust gases to enter air inlet / windows etc.</p> <p>The air intake and exhaust system shall be provided with:</p> <p>Air intake filter and silencer.</p> <p>Exhaust gas driven turbocharger.</p> <p>Charge air cooler.</p> <p>Exhaust gas silencer.</p> <p>Necessary exhaust pipe, supports, hangers, expansion joints and insulation</p> <p>Exhaust stack, shall be self-supported. The stack shall be complete with all accessories and insulated up to a height of two (2) meters from ground level for personal protection.</p> <p>The height of the exhaust stack shall be as per Latest Central Pollution Control Board (CPCB) regulations based on the following formula:</p> $H = h + 0.2 \sqrt{KVA}$ <p>where:</p> <p>H = Total stack height in metres</p> <p>h = Height of diesel generator building in metres</p> <p>KVA = Maximum capacity of alternator.</p>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

Emission Limits: For diesel engine up to 800kW for Genset application following table shall be applicable as per latest CPCB Norms;

Power Category (kW)	Emission Limits ( g/kW-hr)			Smoke limit (light absorption coefficient, m-1)
	NOx + HC	CO	PM	
Upto 19	≤ 7.5	≤ 3.5	≤ 0.3	≤ 0.7
19- 75	≤ 4.7	≤ 3.5	≤ 0.3	≤ 0.7
75-800	≤ 4.0	≤ 3.5	≤ 0.2	≤ 0.7

Note:

1) NOx - Oxides of Nitrogen , HC- Hydrocarbons, CO- Carbon Monoxide and

PM – Particulate Matter

2) Testing shall be as per D2-5 mode cycle of ISO 8178 Part 4

### 10.0

#### **NOTES**

The engine H.P. should be selected so as to achieve required **KW** rating to be generated at site condition and derated considering temperature inside acoustic enclosure.

D.G. set should be highly fuel efficient.

DG Set Rating Suitable for 50 Deg Ambient temperature.

B check of DG Set after 500Hrs or 1Year whichever is earlier.

Base Frame manufactured from CRCA Sheet with shot Blasting procedure.

Coolant Life is 6000Hrs.

Maximum operating temperature :- 95 degree C

Surface treatment of Acoustic enclosure-14tank process-Restrict corrosion.

AMF Controller having extra features like Earth Fault,RPR Etc.

Service Interval after 500Hrs or 1 Year which ever is earlier.

D.G. set should be able to start by push button AMF relay, or remote command.

The engine test shall be witnessed by the OWNER's representative.

The engine should have automatic belt tensioning arrangement for battery charging alternator system. The engine should have facility for the indication of oil level in oil sump during running of the engine.

Engine should be fitted with electronic governor & CRDI Injection system.

The engine water circular pump should be directly driven by engine gear system. V-belt driven system should not be adopted / accepted.

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>11.0</b>	<p><b><u>DRAWING &amp; INFORMATION</u></b></p> <p>ALONGWITH OFFER</p> <p>The bidder shall submit completely filled data sheet as per the given format along with GA drawing indicating list of accessories.</p> <p>Submit list of spare parts required for safe operation of equipment for Two years.</p>
<b>12.0</b>	<p><b><u>HANDING OVER DOCUMENTS</u></b></p> <p>The supplier shall submit following:</p> <ol style="list-style-type: none"> <li>1. GA drawing</li> <li>2. Foundation layout</li> <li>3. Rating and Diagram Plate</li> <li>4. Data sheet indicating results of tests</li> <li>5. Test reports O &amp; M manuals.</li> </ol>
<b>13.0</b>	<p><b><u>METHOD OF MEASUREMENT</u></b></p> <p>Supply of the D.G Set including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.</p>
<b>14.0</b>	<p><b><u>TRANSPORT, DELIVERY &amp; STORAGE</u></b></p> <p>The prices shall be <b>F.O.R. site basis</b> including packing &amp; forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of DG SET or site store. The DG SET should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including <b>transit insurance</b>. The charges for loading and unloading of equipments at site should form part of offer.</p> <p>The transportation for any auxiliary item or detachable part of equipment should be simultaneous and carry necessary instructions for assembling and storage requirements.</p> <p>All metal surfaces shall be thoroughly cleaned of scale, rust and grease etc. Prior to painting. Cleaned surfaces shall be given two coats of primer and prepared for final painting. Final finish shall be free from all sorts of blemishes.</p> <p>The equipment shall be shipped to site suitably packed to prevent any damage. Each package shall have labels to show purchaser's name, purchase order and equipment no. suitable lifting lugs etc. shall be provided and lifting points shall be clearly marked on the package. Packing shall be suitable for storage at site for a minimum period of 6 months.</p> <p>The transportation for any auxiliary item or detachable part of equipment should be simultaneous and carry necessary instructions for assembling and storage requirements.</p> <p>All metal surfaces shall be thoroughly cleaned of scale, rust and grease etc. Prior to painting. Cleaned surfaces shall be given two coats of primer and prepared for final painting. Final finish shall be free from all sorts of blemishes.</p> <p>The equipment shall be shipped to site suitably packed to prevent any damage. Each package shall have labels to show purchaser's name, purchase order and equipment no. suitable lifting lugs etc. shall be</p>



**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

	provided and lifting points shall be clearly marked on the package. Packing shall be suitable for storage at site for a minimum period of 6 months.
<b>15.0</b>	<p><b><u>GUARANTEE &amp; WARRENTY</u></b></p> <p>The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply. The Purchaser also reserves the right to use the rejected equipment or part thereof until the new equipment meeting the guaranteed performance is supplied by the Bidder.</p>
<b>16.0</b>	<p><b><u>SPARES</u></b></p> <p>The bidder shall quote for minimum spares required for two years safe operation of DG set along with the offer separately.</p>
<b>17.0</b>	<p><b><u>Fuel tank</u></b></p> <p>Day storage Fuel tank for minimum 990 ltr capacity fabricated out of 3mm thick MS sheet, with M.S. fuel pipe line, high &amp; low level indicator and alarm contacts. Day storage tank to DG set piping works included.</p> <ul style="list-style-type: none"> <li>• Mild Steel Class-C type pipe line shall be installed from the diesel storage tank to DG set for filling of diesel with including Non-return valve, ball valve, flow meter with accessories.</li> </ul>
<b>18.0</b>	<p><b><u>Fuel transfer pump</u></b></p> <p>Electrical driven rotary gear flame proof pumps suitable for pumping of fuel from Day storage tank to DG tank and feeding the overflow in DG tank back to Day storage tank complete as per the piping schematic and consisting of following:</p> <ul style="list-style-type: none"> <li>• Horizontally mounted pump capable of delivering 30 LPM at 10 Mtr. Head while running at required 1440 RPM, complete with proper connection to suction and delivery line, bypass arrangement against over pressure.</li> <li>• Flame proof motor suitable for 433 + 10% V, 3 phase, 50 Hz AC supply and of suitable HP for the above pumps.</li> <li>• Flame proof ON/ OFF push button station suitable for above motor including connection and inter connection with starters' installed in MCC.</li> <li>• Common base plate of required strength manufactured out of MS channels.</li> <li>• Suitable RCC foundation and anti vibration damping arrangement with cushy foot or similar mounting arrangement.</li> <li>• Coupling and coupling guard for direct coupling of pump and motor.</li> <li>• Pressure gauge with valve on the delivery side.</li> <li>• Strainer at inlet.</li> </ul>

<b>TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS</b>
--

<b>19.0</b>	<b><u>Operation &amp; Maintenance</u></b>  Minimum 5 years Operation & Maintenance after DLP period as per tender shall be included in OEM scope. The detailed scope of work shall include yearly testing and authentication of the system. The report of O&M shall be provided as per clients / OEM formats regularly to the facility management team of the client.
<b>20.0</b>	<b><u>LIST OF ATTACHMENT</u></b>  Annexure 1: Data sheet for D.G. set

<b><u>13.0 TECHNICAL SPECIFICATIONS FOR INSTALLATION OF DIESEL GENERATOR SYSTEM</u></b>	
<b>1.0</b>	<b><u>SCOPE</u></b>
<b>1.1</b>	This specification covers the Installation, testing, commissioning and performance of emergency diesel generator. The scope includes supply, installation, testing and commissioning of D.G. set along with fuel pipeline, residence type exhaust pipe insulation and all the accessories required for trouble free operation.
<b>2.0</b>	<b><u>CODES &amp; STANDARDS</u></b>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

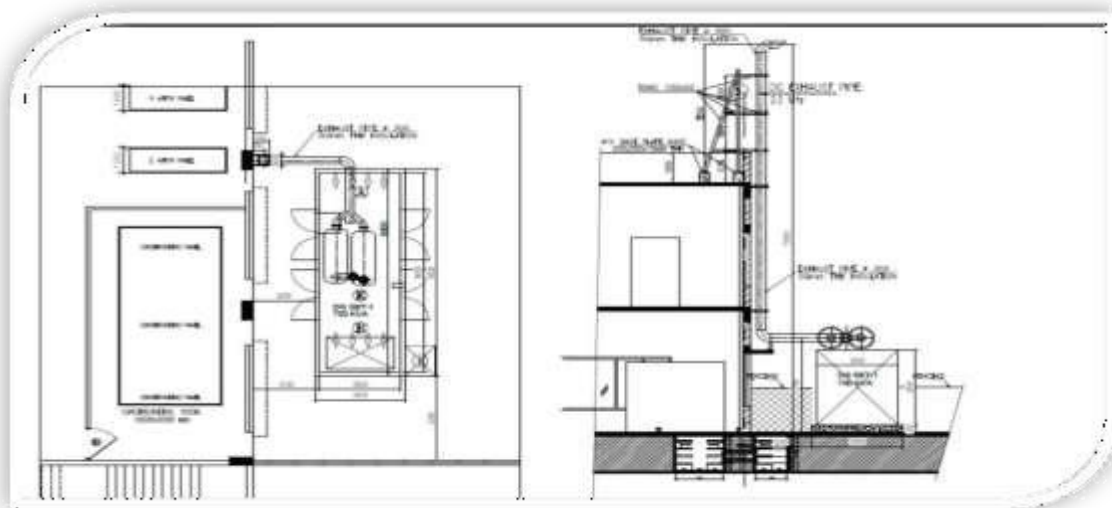
<b>2.1</b>	The Installation, testing, commissioning testing and performance of DG set shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards and codes of practice.				
		<b>Sr .</b>	<b>Item</b>	<b>Relevant IS</b>	<b>Relevant IEC</b>
		<b>1</b>	Designation for type of construction and mounting arrangement of rotating electrical machines.	IS: 2253	
		<b>2</b>	Degree of protection providing by enclosures of rotating electrical machinery.	IS: 4491	
		<b>3</b>	Terminal marking of rotating electrical machines.	IS: 4728	
		<b>4</b>	Guide for testing 3 Phase Synchronous Machines.	IS: 7132	
		<b>5</b>	Turbine type generators.	IS: 5422	
		<b>4</b>	Methods of determination of efficiency of rotating electrical machines.	IS: 4889	
		<b>7</b>	Insulating materials for Electric machinery and apparatus in relation to their thermal stability service, classification.	IS: 1271	
		<b>8</b>	Specification for rotating electrical machines.	IS: 4722	
<b>3.0</b>	<b><u>INSTALLATION OF SYSTEM</u></b>				
<b>3.1</b>	<b><u>ENGINE STARTING</u></b>				
<b>3.1.1</b>	Diesel engines shall be capable of starting without the use of cold starting aids so long the ambient temperature at the site is not below 3°				
<b>3.1.2</b>	Where the diesel engine is specified / offered with battery starting arrangement, the starter motor shall be capable of starting the engine without having to disengage the driven machine with the help of a clutch. Where the diesel engine is equipped with a dual starter the synchronizing switch and the corresponding wiring / connection with the starter motor shall be provided by the vendor				

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>3.1.3</b>	In case of diesel engines driving the engine mounted battery charging alternator, the Vendor shall also provide Battery, automatic Electronics float & boost type battery charger suitable for taking power from supply authority's power source and mounted on a free standing type of a panel.
<b>3.1.4</b>	The battery charger as specified in the equipment data sheet, shall be capable of delivering a current equal to 100% of the 10 hour discharge rate of the battery and also equipped with charging rate selector device
<b>3.1.5</b>	As specified in the data sheets, the diesel engine is required to start / stop automatically; the vendor shall provide the necessary controls (automatic - cum -manual) in the engine panel and the interconnecting wiring and piping from the panel to the engine and starting equipment. A pilot lamp shall be provided in the line side of the starting equipment circuit to indicate that the controller is in the automatic position. In the event the engine does not start after three attempts have been made, the controller shall stop all further cranking and operate the audio-visual alarm. Shaft driven lubrication system is acceptable; alternatively D.C. motor driven lubrication pump with timer suitably interlocked with the starting system is acceptable.
<b>3.2</b>	<b><u>SYSTEM OPERATION</u></b>
<b>3.2.1</b>	The emergency generator set shall normally be in an unattended area. The control system shall operate in fail safe mode and shall include all controls and protection necessary for the safe operation of the package. The generator set shall function as per one of the following schemes: Manual start in service mode. Manual test mode.
<b>4.0</b>	<b><u>INSPECTION &amp; TESTING</u></b>
<b>4.1</b>	The vendor shall have the responsibility of providing purchaser's representative with all requisite facilities / equipment for carrying out satisfactory testing
<b>4.2</b>	The diesel engines shall be tested in the presence of purchaser's representative accordance with latest edition of B.S. 5513 or any other equipment standard as agreed to with the purchaser before the finalization of order
<b>4.3</b>	The routine load and fuel consumption test shall be of the 3 hours
<b>4.3</b>	Unless otherwise specified, 10% overload provision shall be kept while setting the fuel limit for the site running
<b>4.4</b>	The engine control panel/s after assembly and wiring, shall be functionally tested in the presence of the client's / consultant's representative
<b>4.5</b>	Functional tests, continuity tests and high voltage test on control panel to establish the performance called for in the specification
<b>4.6</b>	Power frequency voltage test on switch gear and mechanical / electrical operational check

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>4.7</b>	Routine tests for alternator as per IS: 3711
<b>4.8</b>	Over speed test (1.1 times the rated speed for 1 minutes.)
<b>4.9</b>	Transient response tests for sudden application and rejection of loads of 15% , 50%, 75% and 100% of rated capacity
<b>4.10</b>	Phase sequence test
<b>4.11</b>	Vibration test
<b>4.12</b>	Noise level test
<b>4.13</b>	Dimensional and alignment test
<b>4.14</b>	Wave from test
<b>4.15</b>	The owner or his authorized representative may visit the works during manufacture of equipment to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given all assistance to carry out the inspection
<b>4.16</b>	Detailed test procedure along with the facilities available at vendors works shall be furnished along with the bid Owner's representative shall be given minimum four weeks advance notice for witnessing the final testing. Test certificates including test records and performance curves etc. shall be furnished for the complete D.G., individual test certificates of engine / alternator / common panel should be submitted, only thereafter complete D.G. would be tested.
	<b>750 KVA D.G. SETS Individual Cylinder head</b> <b>12 Cylinder , V60 Design for better Block Loading Capacity</b> <b>Highest Block Loading Capacity in 750KVA</b> <b>Factory Made DG Set with dAMF PANEL</b> <b>Control Panel – with World class Deep Sea Controller ( as per CBPC NOMES 2) ( As per directed by electrical incharge )</b>



Schematic diagram for exhaust piping of DG Set.

**14.0 D.G. SET OPERATION AND MAINTENANCE TERMS AND SCOPE**

**Annexure 1 Preventive Maintenance Scope**

**1.0 PREVENTIVE MAINTENANCE CONTRACT**

**1.1 Intent & Coverage**

The intent of this contract is to ensure almost zero breakdown of the Transformer & D.G set at any point of time through scheduled maintenance program and provide maximum uptime for critical application.

The Contract shall be effective after issue of completion certificate of work and complete after 5 year.

To maintain the facility and conduct diagnostic tests to keep system downtime low and ensure very low breakdown.

To ensure fastest turn-around times possible to get system back to running condition in case of break down.

**1.2 Scope of Maintenance Contract**

The scope of the comprehensive maintenance contract shall cover regular servicing of all rotating and static items which affect the smooth running & intended operating performance of equipment as well as directly or indirectly affect energy consumption of the system.

You shall provide the client with a call escalation matrix, which helps CLIENT to trigger your services in case of any major issues, which may require assistance you're your senior staff members.

All major parts shall be available at site for immediately replacement in case of break down

**1.2.1 Regular Service**

i. All equipment will be checked and serviced 4 times in a year. This service shall also be provided during warranty period.

ii. Each such preventive maintenance service shall mainly consist of:

**2**

a. Checking general functioning of all the running equipment.

b. Attending Break down call as and when called upon by the owner.

**Note:**

a. Above program is indicative

. The Maintenance program and schedule shall also consider the data provided in respective maintenance manuals of major equipments provided either by principal Transformer & D.G set contractor as well as outsourced equipment.

**1.2.3 Day-to-day / Routine Maintenance activities**

Contractor shall prepare a detailed list of parameters that affect smooth operation/performance of major equipments and also effect energy consumption of the system.

Day-to-day / routine maintenance of Transformer & D.G set shall be programmed to ensure desired performance of above parameters. The guidelines for the program shall be as under but not limited to:

**Annexure 2 Operating Contract Scope**

**1.0 OPERATING CONTRACT**

**1.1 Intent and Coverage**

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

The contract shall be effective from the day of satisfactory commissioning and handing over of the system to Client.

The intent of this contract is to generate and implement good operation policies and procedures during the operating period that will ensure a trouble free maintenance record and maximize plant uptime.

The Contract shall be effective after issue of completion certificate of work and complete after 5 year.

### 1.2 Operator Qualification & Experience

(1) Operator shall be Minimum ITI Electrician passed and having minimum 3 years experience of operating similar capacity in corporate/government setup.

(2) Technician shall be of minimum of 5 years of experience and Diploma Electrical Holder.

(3) Entire operations and maintenance of the Transformer & D.G set system shall be under supervision of the One Engineer. Engineer shall be B.E. Mechanical and minimum 3 years of experience of the similar nature of the work.

### 1.3 Scope

a. Contractor shall engage and deploy skilled operator/s for Transformer & D.G set, minimum Two ITI electrician and One Diploma Electrical Holder during day time shift of 8 hours, minimum Two ITI electrician and One

Diploma Electrical during remaining two shifts , who will operate and maintain the desired Transformer & D.G set. One Engineer shall be supervising the operations and maintenance of the Transformer & D.G set system at least for two hours, signing and submission of the reports

on day to day basis. Timing of engineer, operator and technician shall be as per the decision of Engineer in-charge and based on requirements of the functioning of the Hospital.

b. Operation of Transformer & D.G set Systems shall be arranged for 24 hours cycle.

c. To conduct periodic maintenance checks to ensure that the equipment settings are optimal and the correct procedure regarding switching on and switching off of critical equipment's like motor etc. are being followed.

d. All the instruments, tools & plants, safety gears etc. required for O&M staff shall be provided by agency, No additional payment shall be paid by PIU.

e. Agency shall provide dress code and I- Card for all O&M staff from day one, No extra payment will be made by PIU on this account.

f. If any operating or maintenance staff is found without dress code penalty will be levied Rs 1000.00 per person per day (Rupees One Thousand Only).

### 1.4 Day-to-day Operation

a. Keeping all units externally cleaned.

b. Check all the rotating machines for smoothness of drive, vibration and noise level.

c. Check and adjust if required belt tension of all V belt drives.

d. Starters will be checked for smooth operation.

e. Daily logging of operating parameters.

### Annexure 3 Terms and Conditions to be agreed

#### 1. Evaluation:

For evaluation of the tender, amount of the bidders will be considered including capital project installation, operations and maintenance.

#### 2. Validity:



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

Starting from the date of the Work Order issued on Principal Contractor, the rates shall be valid for 5 years after completion of work.

### 3. Taxes and Duties:

The above rates are inclusive of all applicable service charges on services provided and also other duties / local taxes viz. GST/CST, service tax and all types of tax as applicable on replaceable items during the course of the contract.

Supply and installation cost of all items supplied as replacement items during the course of Maintenance contract shall be deemed to have been included in above rates and shall be supplied free of cost at site.

### 4. Retention Money:

PIU will withheld additional 5% of total amount of Electrical work for O & M cost for whole five years from the running R.A. bills.

### 5. Terms of Payment:

Operations and Maintenance: Amount of operations & Maintenance will be released in two equal installments after completion of fourth & fifth year after satisfactory performance acceptable to client.

### 6. Penalty on lapse in Services:

(A) In a case where staff recruited for O & M of Transformer & D.G set is not

as per the agreed 'Operation staff required for Transformer & D.G set, per day wages of absent staff will be deducted from the Contractor's running O & M bill.

(B) In a case where any of the Transformer & D.G set is in non-working condition per day 0.1% of Transformer & D.G set costs will be deducted from running O&M bill maximum up to 10% of Transformer & D.G set costs.

(C) If Operation staff will not be deployed as per requirement deduction of salary as per minimum wages of Government plus 10% of salary as penalty will be made for each staff.

### 7. Tri Party Agreement:

The successful bidder will have to submit tri party agreement between bidder, equipment supplier & client at the time of submission of final bill of project.

Contractor & equipment supplier are solely responsible for continues working of Transformer & D.G. Set & Other equipment

## TECHNICAL DATA SHEET FOR DIESEL GENERATOR SET

SR.NO.	PARTICULARS	REQUIRED DATA	DATA TO BE FURNISHED BY VENDOR
1.0	Prime mover	Diesel Engine  BEE rated DG set (start rated as per Super ECBC 2017)	
2.0	Quantity required	1 Nos. <b>750 KVA</b>	

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

3.0	Service	Prime mover for generating set		
4.0	<b>Rating</b>	<b>750 KVA</b>		
5.0	RPM	1500		
6.0	Voltage	433 V TPN, $\pm 5\%$		
7.0	Voltage variation / regulation  Steady state - slow variation  In load (0.0% to 100% at P.F. 0.8)	1% or less		
8.0	Voltage deep (sudden load application 0.0% to 100% at P.F. 0.8)	5%, recovery time - 0.25 sec.		
9.0	Frequency	50 Hz.		
10.0	Frequency variation / regulation	0.5 Hz.		
11.0	Temperature rise	Class 'F'		
12.0	Alternator Insulation Material	VPI Insulation preferred		
13.0	Flywheel	Required		
14.0	Vibration damper	Required (fluid type only)		
15.0	Fuel pump air cleaner	Required		
16.0	Fuel pump	Required		
17.0	Oil filter, fuel filter etc.	Required		
18.0	Lube oil pump	Required		
19.0	24 V DC electrical system	Required		

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

	consisting of SMF lead acid battery set and suitable charger			
20.0	Safety controls	Required		
21.0	Residential type Silencer	Required		
22.0	Acoustic Hood	Required		
23.0	Standard panel with isolator	Required		
24.0	Coupling	Required		
25.0	Instrument panel consist of a ) Starter switch with key b ) Lub oil temp. gauge c ) Water temp. gauge d ) Lub oil pressure gauge e ) Tacho cum Hour meter	Required Required Required Required Required		
26.0	Fuel tank	Required		
27.0	Battery charger	Required (Electronics float & boost type)		
28.0	Engine testing a) At shop b ) At site	Required		
28.0	Tool kits	Required		
29.0	Literature (Two sets each) a) Operation & maintenance manual b) Parts catalogue / list	Required Required		

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

**TECHINICAL DATA SHEET TO BE FURNISHED BY MANUFACTURER/SUPPLIER**

SR. NO.	PARTICULARS	DESCRIPTION
<b>1.0</b>	<b>DIESEL ENGINE &amp; AUXILIARIES:</b> <b>(DESIGN FEATURES)</b>	
1.1	Name of manufacturer	
1.2	Rating standard BHP	
1.3	Engine rating at site	
1.4	Maximum engine rating at site	
1.5	<b>Derating factors</b>	
a)	Altitude	
b)	Inlet air temperature	
c)	Humidity	
d)	Others	
1.6	Period of maximum engine rating	
1.7	Operating speed	
1.8	No. Of strokes per cycle	
1.9	No. Of cylinders	
1.10	Arrangement of cylinders	
1.11	Rotation direction (Viewed from alternator end)	
1.12	Compression ratio	

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

1.13	Super charging air pressure at rated speed	
1.14	Firing order (Viewed from power take-off end)	
1.17	Fuel system injector pressure	
1.18	Fuel system booster pump pressure	
1.19	Lub. Oil temperature at pump in engine sump	
1.20	1.1 Lub. Oil pressure at pump discharge	
1.21	1.2 Minimum level of lub oil	
1.22	<b>2 Fuel oil system</b>	
1.22.1	Type	
1.22.2	Filters:	
a)	Type	
b)	Number	
c)	Location	
1.22.3	Day tank:	
a)	Capacity	
b)	Material	
c)	Location	
1.22.4	Grade of fuel oil to be used	
1.23	Lub. Oil system	
1.23.1	Type	

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

1.23.2	Filters:	
a)	Type	
b)	Number	
c)	Location	
1.23.3	Lub. Oil tank (sump):	
a)	Capacity	
b)	Material	
c)	Location	
1.23.4	Grade of Lub. Oil to be used	
1.23.5	Lub. Oil pump:	
a)	Type	
b)	Capacity	
1.23.6	Lub. Oil cooler:	
a)	Type & heat transfer area	
b)	Oil inlet and outlet temperature	
1.23.7	Lub. Oil change period	
1.24	<b>Jacket water system:</b>	
1.24.1	Type	
1.24.2	Quality of water to be used	
1.24.3	Quantity of water (Mtr.cu./hr.)	
a)	Engine cooling circuit	

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

b)	Lub. Oil cooler	
c)	Turbo charged cooler	
1.24.4	Make up tank:	
a)	Capacity	
b)	Material	
c)	Location	
1.25	<b>Air intake system:</b>	
a)	Intake filter type	
b)	Location	
1.25.1	Total air quantity required:	
a)	For engine	
b)	For cooler	
c)	For charging	
1.26	<b>Exhaust gas system:</b>	
1.26.1	<b>Manifolds:</b>	
a)	Location	
b)	Size	
c)	Construction	
d)	Material	
1.26.2	<b>Exhaust silencer:</b>	
a)	Type	

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

b)	Location	
c)	Quality of exhaust gas	
1.27	Minimum loading of D.G. sets up to which it can be operated economically	
1.28	Period between major overhauling	
1.29	Starting time of D.G. sets	
1.30	List of all auxiliaries with ratings	
1.31	List of spare parts for 2 years maintenance period	
<b>2.0</b>	<b>GENERATOR AND ACCESSORIES :</b>	
2.1	Name of the manufacturer	
2.2	Design rating	
2.3	Continuous output rating at site conditions	
2.4	Maximum rating	
2.5	Power factor	
2.6	Rated voltage and time taken to reach full voltage	
2.7	Method of Excitation and regulation	
2.8	Rated current per phase	
2.9	Speed	
2.10	Frequency	
2.11	<b>Insulation class:</b>	
a)	Stator	



TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

b)	Rotor	
c)	Exciter	
a	Temperature rise above ambient (by thermometer)	
a)	Stator	
b)	Rotor	
c)	Core	
2.13	Generator parameters:	
a)	Synchronous reactance	
b)	Transient reactance	
c)	Sub-transient reactance	
d)	Zero sequence reactance	
e)	Negative sequence reactance	
f)	Resistance of field winding at operating temperature	
g)	Resistance of stator winding at operating temperature	
h)	Maximum circuit current	
i)	Duration for which D.G. set can withstand above	
<b>3.0</b>	<b>PERFORMANCE GUARANTEE:</b>	
3.1	Net electrical output at site after engine derating factors and auxiliary power requirements have been taken into account	

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

3.2	Fuel oil consumption (actual) :	
a)	¼ load	
b)	½ load	
c)	¾ load	
d)	Full load	
3.3	Lube. oil consumption at rated load (actual) per engine hour operation	
3.4	Jacket water temperature 'IN' to engine.	
3.5	Jacket water temperature 'OUT' from engine.	
3.6	Lub. Oil temperature 'IN' to engine.	
3.7	Lub. Oil temperature 'OUT' from engine.	
3.8	Vibration and noise at rated output.	
3.9	Generator efficiency:	
a)	¼ load	
b)	½ load	
c)	¾ load	
d)	Full load	
3.10	AMF compatibility	
3.11	Generation cost per unit including fuel oil cost, lube oil cost, maintenance & spares cost supporting with calculation	
3.12	Engine life in hours	

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

4.0	<b>WEIGHT SCHEDULE:</b>	
4.1	Weight of engine with fly wheel including standard accessories	
4.2	Weight of generator with exciter	
4.3	Weight of common base frame	
4.4	Heaviest single piece to be handled during erection and maintenance and its weight	
5.0	<b>DIMENSIONS:</b>	
5.1	Maximum dimensions of the single item to be transported	

<b>15.0 TECHNICAL SPECIFICATIONS FOR TTA (IEC-61439) MEDIUM VOLTAGE PANEL</b>																																																											
<b>1.0</b>	<b><u>SCOPE OF WORK</u></b>																																																										
<b>1.1</b>	This scope shall cover design, manufacture, check test, and supply of medium and low voltage motor/power control Panel boards, MCB distribution boards etc. as described in this specification, as per drawings and schedule of quantities.																																																										
<b>2.0</b>	<b><u>CODES &amp; STANDARDS</u></b>																																																										
<b>2.1</b>	The Panels shall comply with the latest edition of relevant Indian Standards and Indian Electricity Rules and Regulations. The following Indian standards shall be complied with:																																																										
	<table border="1"> <thead> <tr> <th>Sr.</th><th>Item</th><th>Relevant IS</th><th>Relevant IEC</th></tr> </thead> <tbody> <tr> <td>1.</td><td>General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC</td><td>IS: 4237</td><td></td></tr> <tr> <td>2.</td><td>Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.</td><td>IS: 375</td><td></td></tr> <tr> <td>3.</td><td>Degree of protection provided by enclosures for Low voltage switches gear and control gear.</td><td>IS: 2147</td><td>IEC60529</td></tr> <tr> <td>4.</td><td>Terminal marking for electrical measuring instrument and their accessories.</td><td>IS: 8197</td><td></td></tr> <tr> <td>5.</td><td>Danger notice plates</td><td>IS: 2551</td><td></td></tr> <tr> <td>6.</td><td>Code of Practice for selection, installation and maintenance of switchgear and control gear.</td><td>IS: 10118</td><td></td></tr> <tr> <td>7.</td><td>Specification for factory built assemblies of switchgear and control gear for voltage up to and including 1000 V AC and 1200 V D.C.</td><td>IS: 8623</td><td></td></tr> <tr> <td>8.</td><td>Miniature circuit breakers.</td><td>IS: 8828</td><td>IEC60947-2</td></tr> <tr> <td>9.</td><td>Current transformers</td><td>IS: 2705</td><td>IEC60044-1</td></tr> <tr> <td>10.</td><td>Voltage transformer</td><td>IS: 3156</td><td>IEC60186</td></tr> <tr> <td>11.</td><td>Electrical relay for protection</td><td>IS: 3231</td><td></td></tr> <tr> <td>12.</td><td>Indicating instruments</td><td>IS: 1248</td><td></td></tr> <tr> <td>13.</td><td>Integrating instruments</td><td>IS: 722</td><td></td></tr> </tbody> </table>	Sr.	Item	Relevant IS	Relevant IEC	1.	General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC	IS: 4237		2.	Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.	IS: 375		3.	Degree of protection provided by enclosures for Low voltage switches gear and control gear.	IS: 2147	IEC60529	4.	Terminal marking for electrical measuring instrument and their accessories.	IS: 8197		5.	Danger notice plates	IS: 2551		6.	Code of Practice for selection, installation and maintenance of switchgear and control gear.	IS: 10118		7.	Specification for factory built assemblies of switchgear and control gear for voltage up to and including 1000 V AC and 1200 V D.C.	IS: 8623		8.	Miniature circuit breakers.	IS: 8828	IEC60947-2	9.	Current transformers	IS: 2705	IEC60044-1	10.	Voltage transformer	IS: 3156	IEC60186	11.	Electrical relay for protection	IS: 3231		12.	Indicating instruments	IS: 1248		13.	Integrating instruments	IS: 722			
Sr.	Item	Relevant IS	Relevant IEC																																																								
1.	General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC	IS: 4237																																																									
2.	Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.	IS: 375																																																									
3.	Degree of protection provided by enclosures for Low voltage switches gear and control gear.	IS: 2147	IEC60529																																																								
4.	Terminal marking for electrical measuring instrument and their accessories.	IS: 8197																																																									
5.	Danger notice plates	IS: 2551																																																									
6.	Code of Practice for selection, installation and maintenance of switchgear and control gear.	IS: 10118																																																									
7.	Specification for factory built assemblies of switchgear and control gear for voltage up to and including 1000 V AC and 1200 V D.C.	IS: 8623																																																									
8.	Miniature circuit breakers.	IS: 8828	IEC60947-2																																																								
9.	Current transformers	IS: 2705	IEC60044-1																																																								
10.	Voltage transformer	IS: 3156	IEC60186																																																								
11.	Electrical relay for protection	IS: 3231																																																									
12.	Indicating instruments	IS: 1248																																																									
13.	Integrating instruments	IS: 722																																																									

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<b>14.</b>	Control switches and push buttons	IS: 6875	
	<b>15.</b>	Low Voltage Switchgear and Control Gears Specifications	IS 13947	IEC 61439-1/2
	<b>16.</b>	Electrolytic Copper / Aluminum	IS 5082	
	<b>17.</b>	AC Electric Meters	IS 14697	
	<b>18.</b>	Circuit Breakers, voltages up to 1000 Volts	IS 2516	
	<b>19.</b>	Air Break Switches, Air Break Disconnectors, for voltages not exceeding 1000V AC or 1200V DC.	IS 4064	IEC60947-3
	<b>20.</b>	Contactors for voltages not exceeding 1000 Volt A.C or 1200 Volts D.C	IS 2959	IEC60 947-4-1
	<b>21.</b>	Residual Current operated Circuit Breakers	IS 12640	
	<b>22.</b>	AC motor starters of voltage not exceeding 1000 V	IS: 1822	IEC60 947-4-1
	<b>23.</b>	Environmental testing/ Seismic Withstand Level		IEEE693
	<b>24.</b>	Protection against electric shock – Common aspects for installation and equipment – Basic safety publication		IEC61140
	<b>25.</b>	TR Internal Arc Test report		IEC61641
The Panels also require approval of the client/consultant at various stage of their manufacture such as design, selection, construction, testing, shipping etc.				
<b>3.0</b>	<b><u>DESIGN BASIS</u></b>			
	All the equipment and components provided in the DG set with accessories shall be suitably designed for installation and satisfactory operation as specified below.			
	Ambient Temperature : Max. / Min. = 50° C. / 5° C.			
	Design temperature : 45 Degree C.			
	Relative humidity : 98% max.			
	Altitude : 35.5 M above MSL			
	Voltage : 415+/- 10%, TPN			
	Frequency : 50 Hz. + 3% to -6%			

# TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	Neutral : Solidly / earthed neutral.			
	Fault level : 24 MVA, Symmetrical at 415V solidly earthed.			
	All the equipment and components provided in the transformer and accessories shall be suitably designed for installation and satisfactory operation as specified below.			
	<b><u>Site conditions</u></b>			
	<b>Location Rajpipla</b>		Gujarat	
	<b>Ambient temperature</b>		<b>Relative humidity</b>	
	Maximum 50 <sup>o</sup> C		Maximum 98 %	
	Minimum 05 <sup>o</sup> C		Minimum 40 %	
	Design 40 <sup>o</sup> C		Design 98 % at 45 <sup>o</sup> C	
	<b>Seismic factor ZONE</b> - III As per IS:1893		Rain fall 1000 mm/year	
	<b>Environmental</b> Non-corrosive, Humid and Dusty		<b>Location of Equipment</b> Indoor	
	<b>Wind speed</b> 22 kmph maximum			
	<b>Electrical system data:</b>			
	<b>Power supply for Equipment</b>			
	Voltage 415 kV ± 5 %		<b>Frequency</b> 50 Hz ± 3 %	
	<b>Permissible combined voltage &amp; frequency variation</b>	± 6 %	<b>System design faults level (Symmetrical)</b>	35 kA – 50 KA – 65KA for 1 sec. max. as per specified in SLD
	<b>System earthing</b> LV side neutral solidly earthed		<b>Wiring</b> 3 phase, 4 wire on 415V system	
	<b>Auxiliary power supply :</b>			
<b>Power supply</b>		240V AC, 1-Ph, 50Hz		
<b>Control Supply</b>		-----		
<b>Space heater power supply</b>		240V AC, 1-Ph, 50Hz		
<b>Illumination power supply</b>		240V AC, 1-Ph, 50Hz		

# **TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

	<b>Plug-socket power supply</b>	240V AC, 1-Ph, 50Hz
<b>4.0</b>	<b><u>GENERAL</u></b>	
	<ul style="list-style-type: none"> <li>• LV Switchboards shall be certified by 3rd party Certification body as per IEC 61439-1 &amp; 2. Test reports without certificate shall not be considered admissible proof of compliance. The Certifying Authority shall be qualified under ISO/IEC 17065 as per IEC 61439-1.</li> <li>• IEC 61439-1&amp;2 compliance certificate to be submitted for all ratings of LV Switchboards as mentioned in Schedule of Quantities or Single Line Diagram for this project along with the tender.</li> <li>• The LV switchboards and the associated equipment including switchgear, control gear, Busbar supports, Busbar orientation, Busbar links etc shall be identical in construction to the assembly which has undergone certification as per IEC61439-1 &amp; 2.</li> <li>• Certified design of switchboards shall be proven design from OEM (Original Equipment/ Switchgear Manufacturer). OEM name should be mentioned on top of each column of switchboard. Also, OEM Partnership Certificate shall be furnished by Panel builder.</li> <li>• To ensure installation consistency during switchboard life cycle, installation system, switchgears, motor starter components and metering devices must be supplied by the same Manufacturer (OEM).</li> <li>• Switchboards shall have a short circuit level withstand as per Schedule of Quantities and drawings. The enclosures shall be designed to take care of normal stress as well as abnormal electro-mechanical stress due to short circuit conditions.</li> <li>• Switchboards shall have Rated Impulse withstand voltage (Uimp) of 12kV for withstanding against transient Overvoltages, for which the values of clearances are referred applicable for ACB, horizontal &amp; vertical busbars.</li> <li>• All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP 42 unless otherwise stated. Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 42 is retained.</li> <li>• Switchboards shall be tested for Internal arc. The test should be performed for arc starting place - at Horizontal busbar, Vertical busbar and in outgoing cable compartments.</li> <li>• As Aluminium busbar are recommended for switchboard - Internal arc test to be performed on switchboards having Aluminium busbar. Reports with Cu busbar design shall not be accepted as proof of compliance.</li> <li>• To ensure right performance on Seismic risk, Switchboards shall be validated design for Seismic withstand for Ground Acceleration level of 2g. Test shall be performed in accordance with standard IEEE 693 : 2018.</li> <li>• Switchboards must have mechanical impact IK10 tested.</li> <li>• In order to facilitate access within the switchboard for maintenance, its covering panels must be dismountable on all surfaces for all IP degrees</li> <li>• To ensure maximum protection of people around the electrical installation, front plates must be installed in front of all control and protection equipment in order to avoid direct access without a tool to the devices and consequently to the live parts.</li> <li>• For safety reasons and especially when the door is open during switchboard operation, all busbars must be covered by Metallic barriers over whole perimeter of the busbar zone. IP2X (touch proof) protection shall be available.</li> <li>• As specified in the BOM the switchboard shall be form 3b. For forms of separation to be achieved, only metallic covers shall be used. Hylem/ PVC sheets shall not be allowed.</li> <li>• To enhance Sustainability, LV Switchboards shall have Green Premium Certification, with eco production, with product design in accordance with RoHS &amp; REACH directives and with End of Life Instructions.</li> <li>• The switchboard shall be supplied with a smartphone/web-based maintenance tracking system. A unique identifier(like QR code) shall be employed for each switchboard to enable quick access to switchboard details including but not limited to switchboard drawings, wiring diagrams, list of spares, Switchboard BOM etc. A maintenance schedule shall be provided by the manufacturer for switchboard and major components inside. There should be a provision to enable alerts for upcoming maintenance activities for the switchboard and components. The alerts shall be automated and provided to the maintenance staff appointed by the End-user in the form of smartphone notifications.</li> </ul>	

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>5.0</b>	<p><b><u>Switchboard Configuration</u></b></p> <ul style="list-style-type: none"> <li>The Switchboard shall be configured with Air Circuit Breakers, MCCB's, MCB's, Motor Starter components, Metering devices and other equipment as called for in the schedule of quantities.</li> <li>The MCCBs shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single tier or Two-Tier formation to facilitate operation and maintenance.</li> <li>The Switchboards shall be of adequate size with a provision of spare space to accommodate possible future additional switch gear.</li> </ul>
<b>6.0</b>	<p><b><u>Constructional Features</u></b></p> <ul style="list-style-type: none"> <li>The Switchboards shall be metal clad totally enclosed; floor mounted free-standing type of modular extensible design suitable for indoor installations. Switchboards, panels and cubicles shall be fabricated with CRCA Sheet Steel of thickness, same as that of tested assembly according to IEC61439-1 &amp; 2. Sheet thickness for Load bearing frame structures shall not be less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. Also, the doors and covers shall be fabricated from CRCA sheet steel of thickness not less than 1.6 mm.</li> <li>All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.</li> <li>Panel shall be supplied with a double door arrangement. Global Door/ Front Door shall be fitted with transparent Glass to allow maintenance staff to visually access device status, meter readings, indicating lamp status without opening the door. IP level &amp; Mechanical impact performance of the panel shall not be compromised in any scenario and shall remain at IP42/54 and IK10 level respectively, in all conditions.</li> <li>Global door shall be provided with Ergonomic handles with locking (key RONIS n° 405).</li> <li>Switchboards construction shall employ the principle of compartmentalized and segregation for each circuit.</li> <li>Incomer and bus section panels or sections shall be separate and independent and shall not accommodate any outgoing feeder. The incomer panel shall be suitable for receiving bus trunking or LV cable of size specified.</li> <li>Switchboards shall be made up of requisite vertical sections, which when coupled together, shall form continuous switchboards.</li> <li>Switchboard shall be readily extensible on both sides by addition of vertical sections after removal of the end covers.</li> <li>The switchboards shall be designed for use in high ambient temperature upto 45 degree centigrade and humid tropical conditions suitable for pollution degree 3.</li> <li>Ease of inspections, cleaning and repairs while maintaining continuity of operation shall be provided in the design.</li> <li>Special care to be taken to ensure effective earthing of the frame and doors of the switchboards.</li> <li>Each vertical section shall be provided with a rear or side cable chamber housing the cable end connections and power/control cable terminations. There should be generous availability of space for ease of installation and maintenance with adequate safety for working in one vertical section without coming into contact with any live parts. The design of the switchboard shall allow standard extension chambers if required to accommodate cables.</li> <li>Some switchboards may be required to be installed against the wall, for such applications, documented designs shall be available.</li> <li>The painting of the sheet metal shall be done by electrostatic spraying of epoxy resin powder to give smooth finish to the equipment. Color used shall be RAL 7047 for the enclosure and RAL 9022 for the functional unit.</li> <li>Switchboard panels and cubicles shall be fabricated with CRCA Sheet Steel of thickness, same as that of tested assembly according to IEC61439-1 &amp; 2.</li> <li>All the devices must be installed onto dedicated mounting plate designed for one or several switchgears of the same type. The objective of this point is to group protection equipment of the same type, as well as distinguish inside the switchboard the function of each device or group of devices and avoid identification mistakes.</li> <li>Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 42/IP 54 as stipulated in schedule of</li> </ul>



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	quantities. The unused openings within the switchboards shall be closed using suitable grommets.
<b>7.0</b>	<b><u>Switchboard Dimensional Limitations</u></b>
	<ul style="list-style-type: none"> <li>The overall height of the switchboard shall be limited to 2000 mm for all the Busbar ratings and type of switchboards. Panel should have integral base frame of 75/100mm, The height of the operating handle push buttons etc shall be restricted between 300 mm and 1800 mm from finished floor level.</li> <li>Other dimensional limits if any are specified separately.</li> </ul>
<b>8.0</b>	<b><u>Switchboard Compartmentalization</u></b>
	<ul style="list-style-type: none"> <li>Switchboard design shall be completely compartmentalised with separate compartments for horizontal busbars, vertical busbars, Cable alleys and functional units consisting of ACBs, MCCBs, &amp; MCB's.</li> <li>Earthed metal or insulated shutters shall be provided between drawout and fixed portion of the switchgear such that no live parts are accessible with equipment drawn out. Degree of protection within compartments shall be atleast IP 2X.</li> <li>For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.</li> <li>Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating and duty. All operating device shall be in front of switchgear only.</li> <li>Separate cable compartments running the height of the switchboard in the case of front access boards shall be provided for incoming and outgoing cables.</li> <li>Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top. The construction shall include necessary and adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley / cable chamber.</li> </ul>
<b>9.0</b>	<b><u>Switchboard Bus Bar</u></b>
	<ul style="list-style-type: none"> <li>Busbars shall be made of high conductivity, and high strength Aluminum E91E or high strength Copper of ETP grade.</li> <li>Busbars shall be of rectangular cross sections better suitable for full load current for phase bus bars and half/ full rated current for neutral bus bar or as stipulated in schedule of quantities. Busbar shall be suitable to withstand the stresses of fault level as specified in schedule of quantities.</li> <li>The maximum temperature of the busbars shall not exceed 90 degree Centigrade.</li> <li>The bus bar system may comprise of a system of main horizontal bus bars and auxiliary vertical bus bars run in bus bar Chamber on either side of Switchgear chamber, so that busbars could be accessed with front access itself.</li> <li>Design of LV Switchboard shall be such that, Phase and Neutral busbars should be together in same compartment. Also, the Neutral busbar shall always be in front to ensure safety, even when covers are open.</li> <li>For ratings upto 1600A, design of LV Switchboards shall be such that Main Horizontal Busbar can be assembled at Top or at Bottom of Switchboard, to achieve less footprint, depending on site conditions viz. Cable Entry from Top/ Cable Entry from bottom etc.</li> <li>The bus bars carrying full current of Switchboard shall be supported on non-breakable, non-hygroscopic epoxy resin or glass fiber reinforced polymer insulated supports that are Thermoset in nature, so as to be able to withstand high operating temperature of 135 deg C and mechanical forces, arising from a severe fault level as stipulated in schedule of quantities.</li> <li>To ensure ability to resist ignition &amp; to self-extinguish when ignited, Insulated supports shall be supplied from OEM only &amp; confirm to Glow Wire Test The Busbar Support and the spacing should be same as per the type tested assembly.</li> <li>Clearances &amp; Creepage distances between phases should be in line with IEC.</li> <li>Continuous earth bus sized for prospective fault current to be provided with arrangement for</li> </ul>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	connecting to site earth at two ends of Switchboard.
<b>10.0</b>	<b><u>Switchboard Interconnection</u></b>
	<ul style="list-style-type: none"> <li>All connection and tap offs shall be through adequately sized connectors appropriate for fault level at location. This shall include tap off to feeders and instrument/control transformers.</li> <li>For unit ratings upto 160 Amps, PVC insulated copper conductor wires of adequate size to carry full load current shall be used. The terminations of such interconnections shall be crimped. Solid connections shall be used for all rating of 200 Amps &amp; above.</li> <li>All connections, tapings, clamping, shall be made in an approved manner to ensure minimum contact resistance. All connections shall be firmly bolted and clamp with even tension. Before assembly joint surfaces shall be filed or finished to remove burrs, dents and oxides and silvered to maintain good continuity at all joints.</li> <li>All screws, bolts, washers shall be zinc plated. Only 8.8 grade nuts and bolts shall be used for Assembly of panels &amp; also busbar connections.</li> </ul>
<b>11.0</b>	<b><u>Drawout Features for ACB</u></b>
	<ul style="list-style-type: none"> <li>Air Circuit Breakers shall be provided in fully drawout cubicles, unless otherwise stated. These cubicles shall be such that drawout is possible without disconnection of the wires and cables. The power and control circuits shall have self-aligning and self-isolating contacts. Mechanical latches shall be integrated in ACB at service, test and isolated position to ensure that Breaker is firmly latched in respective position. It shall not be possible to move the breaker from the position unless latch is manually operated.</li> </ul>
<b>12.0</b>	<b><u>Instrument Accommodation/Meters</u></b>
	<ul style="list-style-type: none"> <li>All voltmeter and ammeter and other instruments shall be flushed mounted type of size 96 sq. mm conforming to class 1.5 to IS 1248 for accuracy. All voltmeter shall be protected with MPCBs.</li> <li>Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided, and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switchboard.</li> <li>For MCCBs, instruments and indicating lamps can be provided on the internal compartment doors.</li> <li>The current transformers for metering and for protection shall be mounted on the solid copper/aluminium busbars with proper supports.</li> <li>On all the incomers of switch boards ON/OFF indicators lamps shall be provided suitable for operation on AC 230 volts supply. All lamps shall be protected by MCBs.</li> </ul>
<b>13.0</b>	<b><u>Wiring</u></b>
	<ul style="list-style-type: none"> <li>All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labeled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 sq. mm. Runs of wires shall be neatly bunched and suitably supported and clamped. Means shall be provided for easy identification of wires. Identification ferrules shall be used at both end of wires. All control wires meant for external connections are to be brought out on a terminal board. The cables and control wires shall be suitable for withstanding 105 deg C.</li> </ul>
<b>14.0</b>	<b><u>Space Heaters</u></b>
	<ul style="list-style-type: none"> <li>Anti- condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 50 C. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the switchboard is in operation. As a rule, the heaters shall be placed at the bottom of the</li> </ul>

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

	cubicle.
<b>15.0</b>	<b><u>Sheet Steel Treatment and Painting</u></b>
	<ul style="list-style-type: none"> <li>Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process after which a coat of primer paint compactively with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50-micron thickness, of sheet approved by Engineer-in-Charge shall then be provided.</li> </ul>
<b>16.0</b>	<b><u>Testing at Works</u></b>
	<ul style="list-style-type: none"> <li>Copies of Routine test carried out at the Panel Builder's Workshop shall be furnished along with the delivery of the switchboards. Engineer-in-Charge reserves the right to get the switchboard inspected by their representative at Panel Builder's works prior to dispatch to site to witness the followings. <ol style="list-style-type: none"> <li>Physical variation and dimensional check</li> <li>Verification of bill of material</li> <li>Functional check</li> <li>HV test</li> <li>IR test</li> </ol> </li> </ul>
<b>17.0</b>	<p><b><u>Synchronization relays (Make and model as per specified in BOQ and make list).</u></b></p> <p><b>Synchronization panel shall be with synchronization relay have following features.</b></p> <p><b><u>STUCKE ECG SYMAP or EQUIVALENT WOODWARD</u></b></p>
	1- Auto Mains Failure function (Blackout Management)
	2- Auto Synchronizing of Generator breaker, Bus Coupler and Grid Breaker
	3- Auto Load Sharing of Active and Reactive Power.
	4- Auto Load Dependent Start/Stop functions inbuilt in relay for Power Management with two load limits (for achieve max. fuel efficiency and two load limit to protect cascade tripping).
	5- Auto Load shedding (to protect cascade tripping)
	6- Inbuilt Numerical Generator Protections which functions on 5P10 CT. <ol style="list-style-type: none"> <li>Under Voltage – 27</li> <li>Over Voltage – 59,</li> <li>under Frequency – 81U</li> <li>Over Frequency – 81O,</li> <li>Over Load – 32,</li> <li>Reverse Power – 32R,</li> <li>Loss of Excitation – 40/Q,</li> <li>Over Excitation – 24,</li> <li>Restricted Earth Fault – 64REF</li> <li>Non – directional over current – inverse current base &amp; definite time base – 50/51</li> <li>Directional Over Current – 67,</li> <li>Non – directional Earth Fault – inverse current base and definite time base – 50N/51N</li> <li>Directional Earth Fault – 67N ,</li> <li>Voltage Restrain Over Current – 51V,</li> </ol>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<ul style="list-style-type: none"> <li>o. Voltage Asymmetry - 47,</li> <li>p. Negative phase sequence - 46,</li> <li>q. Vector surge – 78,</li> <li>r. <math>df/dt</math> – 81R,</li> <li>s. Fuse failure – 60FL,</li> <li>t. Circuit breaker Failure Protection – current base – 50BF,</li> <li>u. Thermal Over Load – 49</li> </ul>
	7- All inputs and outputs are configurable.
	8- Inbuilt PLC (for interlocking of Bus Coupler, Mains Breaker and Generator Breaker)
	9- Customize SLD in Controller and Breaker Control from Controller.
	10- Measurement of Voltage, Current, Power, Frequency, Power Factor, Energy and Harmonics measurement (up to 5 <sup>th</sup> Harmonics - % THD)
	11- Require minimum 5000 Event Records for easy diagnosis.
	12- Also require 1000 Fault Records for easy diagnosis.
	13- 80 Alarms configurable with customize editable text.
	14- Also make Annunciation Page in Controller.
	15- Capable to expand extra input/outputs via Extension boards
	16- RS 232 in front and RS 485 - Modbus in rear for communication with PC and For BMS.
	17- CAN # 1 for Relay communication and extend the Binary and Analogue inputs as well as outputs with expansion boards.
	18- The software and PC communication cable is provides with relay free of cost.
	19- Controller Should be in Stainless steel housing with liquid gasket for IP54.
<b>18.0</b>	<b><u>DRAWING &amp; INFORMATION</u></b>
	Prior to fabrication of the Panels the supplier/contractor shall submit for consultant's approval the shop/vendor drawing consisting of G.A. drawing, sectional elevation, single line diagram, bill of material etc. and design calculations indicating type, size, short circuiting rating of all the electrical components used, busbar size, internal wiring size, Panels dimension, colour, mounting details etc.. The contractor shall submit manufacturer's catalogues of the electrical components installed in the Panels.
<b>19.0</b>	<b><u>TRANSPORT, DELIVERY &amp; STORAGE</u></b>
	The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of site or site store. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer
	All the items will be measured as mentioned in Bill of quantity.

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

<b>20.0</b>	<b><u>GUARANTEE &amp; WARRENTY</u></b>
	The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier.
<b>21.0</b>	<b><u>SPARES</u></b>
	The bidder shall quote for minimum spares required for two years safe operation of transformer along with the offer separately.
<b>22.0</b>	<b>Energy and Power Management Software Specification (EMS)</b>
	<p><b><u>22.1 Software - General:</u></b></p> <p>10. Furnish a dedicated, edge control, software platform (The Software Platform) that is purpose-built to be the operational interface for an Energy and Power Management System (EPMS) whose primary purpose is to support the provision and management of safe, reliable and efficient power within buildings and facilities. The Software Platform shall have specialized data acquisition, visualization, analysis and reporting tools specifically designed for Power Management applications such as:</p> <ul style="list-style-type: none"> <li>a. Electrical Distribution System Monitoring and Alarming.</li> <li>b. Electrical System Capacity Management.</li> <li>c. Power Quality Monitoring and Compliance.</li> <li>d. Multi Source Management.</li> <li>e. Continuous Electrical Thermal Monitoring.</li> <li>f. Breaker Setting Monitoring.</li> <li>g. Backup Power Testing.</li> <li>h. Power Events Analysis.</li> <li>i. Energy Usage Analysis and Energy Benchmarking.</li> <li>j. Utility Bill Verification and Cost Allocation.</li> <li>k. Energy Performance Analysis and Verification</li> </ul> <p>11. The Software Platform shall natively support (no additional installation or configuration of the software required) at least 100 devices specifically designed for power distribution and power quality monitoring including: programmable power analyzers, power meters, branch and multi-circuit meters, smart panels with communicating circuit breakers, protection relays, uninterruptable power supplies, active harmonic filters, capacitor bank controllers, electrical distribution thermal sensors.</p> <ul style="list-style-type: none"> <li>a. All registers shall be pre-mapped to standard measurement names – no additional register mapping required.</li> <li>b. All native device types will come with a comprehensive set of a factory device graphical screens – no additional graphics creation or installation required.</li> </ul>

	<p>c. All native device types have been factory-tested and proven to perform.</p> <p>12. The Software Platform's web applications shall be simultaneously accessible from their unique web addresses so that they may be embedded in other web-based software environments.</p> <p>13. The functionality of the Software Platform shall be extensible whereby additional capabilities may be added via software license activation codes without the need to install additional software modules or add-ons.</p> <p>14. The Software Platform shall be certified as part of an Energy Data Management System according to the sections of the following ISO standards:</p> <p>d. ISO 50001</p> <ul style="list-style-type: none"> <li>i. Energy review</li> <li>ii. Energy baseline</li> <li>iii. Energy performance indicators</li> <li>iv. Monitoring, measurement, and analysis</li> <li>v. Input to management review</li> </ul> <p>e. ISO 50002</p> <ul style="list-style-type: none"> <li>i. Data collection</li> <li>ii. Measurement plan</li> <li>iii. Analysis</li> <li>iv. Energy audit reporting</li> </ul> <p>f. ISO 50006</p> <ul style="list-style-type: none"> <li>i. Obtain relevant energy performance information from the energy review</li> <li>ii. Identify energy performance indicators</li> </ul> <p>15. The Software Platform shall be certified to comply with cyber security standard IEC62443 at the component level: IEC62443-4-1 and IEC62443-4-2 (SL1).</p> <p>16. The Software Platform shall be designed to streamline the process of checking and maintaining EN50160 and IEEE 519 Power Quality compliance.</p> <p>17. The Software Platform shall natively support the vendor's continuous electrical thermal monitoring system with the ability to detect abnormal bus bar or cable temperatures due to loose or faulty connections and to prevent equipment damage and fire.</p> <p>18. The Software Platform shall be designed to integrate and embed within the vendor's Building Management System (BMS) software platform to provide Energy and Power Management applications within the context of the BMS environment.</p>
	<p><b><u>22.2 Software - Real Time Monitoring:</u></b></p>
	<p>5. The Software Platform shall support Auto Network Diagram Creation whereby a comprehensive set of linked hierarchical graphical diagrams is automatically created for all directly connected devices in the power monitoring network.</p> <p>6. The Software Platform shall support advanced power quality meters with onboard High Speed</p>

	<p>Power Analysis with Disturbance Direction Detection (DDD) capabilities and come equipped with a built-in set of real-time graphical indicators for use in electrical one-line diagrams that indicate:</p> <ol style="list-style-type: none"> <li>The type of Power Quality Disturbance (sag, swell, transient).</li> <li>The direction of Power Quality Disturbance relative to the compliant DDD device (upstream, downstream).</li> </ol> <p>7. The Software Platform shall provide real-time indication of the aggregated demand being measured by one or more devices in a predefined zone. The application shall allow:</p> <ol style="list-style-type: none"> <li>The demand for the zone to be expressed using either Kilowatts or normalized Kilowatts/Area.</li> <li>Visual indication of how the present demand for a zone compares with four (4) configurable limits / targets using a color scale.</li> <li>Configurable limits shall be further configurable to allow for the use of different values during an On-Peak period compared to an Off-Peak period.</li> </ol> <p>8. The Software Platform shall allow web client users to quickly and easily create interactive dashboard visualization of any real-time measurements that:</p> <ol style="list-style-type: none"> <li>Display tabular and trend line views to compare device readings from multiple devices in the power monitoring network including power meters, circuit breakers, protection relays, uninterruptable power supplies, automatic transfer switches and generators.</li> <li>Permit users to create, modify, view and share views directly from the web client browser without the need for a separate software application.</li> <li>Support both physical and virtual devices defined in the system.</li> <li>Support exporting real time data into Excel formats directly from the web client browser environment.</li> </ol>
	<p><b><u>22.3 Software – Alarm and Event Analysis and Notification:</u></b></p>
	<p>8. The Software Platform shall be able to acquire specialized, high speed power disturbance data directly from onboard advanced power quality meters for the purpose of Power Events Analysis, including:</p> <ol style="list-style-type: none"> <li>Timestamped Power Events with Disturbance Direction Detection (DDD).</li> <li>Timestamped high speed (1/2 cycle sample rate) pre/post event RMS data.</li> <li>Pre/post event waveform captures (Voltage and Current all phases).</li> </ol> <p>9. The Software Platform shall provide a web based power events analysis application that includes but is not limited to the following features:</p> <ol style="list-style-type: none"> <li>Automatic, intelligent clustering of events into alarms and multiple alarms from multiple devices into “incidents” to simplify the analysis of multiple cascading events.</li> <li>Automatic categorization of alarms and incidents into predefined categories such as Power Quality, Power Availability, Diagnostics and Other.</li> <li>Predefined views for events, alarms and incidents with intuitive navigation and easy to</li> </ol>

	<p>use, configurable filters based on priority, status, source and categories.</p> <ul style="list-style-type: none"> <li>d. Ability to create private or shared event, alarm and incident views with custom filters.</li> <li>e. Popup window with detailed information about where, what and when an alarm or incident happened, plus other relevant information including Power Quality details and a thumbnail summary view of all waveforms associated with the alarm or incident.</li> <li>f. For Power Quality alarms or incidents captured by Disturbance Direction Detection (DDD) compliant devices there shall be clear graphical indication of the direction of the disturbance (upstream or downstream relative to the DDD compliant device).</li> </ul> <p>10. The Software Platform shall provide a graphical timeline view of alarms and events that constitute an “incident” in the electrical distribution network. The timeline view shall:</p> <ul style="list-style-type: none"> <li>a. Display alarms/events stacked by order of time for sequence of events analysis.</li> <li>b. Display the start and end of alarms/events with color-coded dots.</li> <li>c. Indicate the direction of a Power Disturbance and if there are captured waveforms associated with the incident.</li> <li>d. Have a configurable analysis window with a color-coded time slider that uses color to indicate areas in the timeline where there are greater numbers of alarms.</li> <li>e. Be able to display pre- and post-event high speed RMS data coming from supported power quality meters.</li> </ul> <p>11. The Software Platform shall include a web-based Smart Waveform Analyzer interface with the following capabilities:</p> <ul style="list-style-type: none"> <li>a. Toggle on/off Voltage/Current channels.</li> <li>b. RMS calculation, zoom, pan, export to CSV.</li> <li>c. Interactive phasor and harmonic (voltage and current) diagrams.</li> <li>d. Allow multiple waveforms to be compared to each other.</li> </ul> <p>12. The Software Platform shall include an alarm annunciator to display the total number of unacknowledged alarms with a breakdown of how many are high, medium and low priority and shall allow easy navigation to the alarm viewer with a single click.</p> <p>13. The Software Platform shall provide the ability to send email notifications based on recent changes to the system which will be used to formulate notification types including:</p> <ul style="list-style-type: none"> <li>a. Communication Loss Notification – sent when the Software Platform loses communication with selected devices.</li> <li>b. Alarm Summary Notification – sent regularly to indicate changes in the average amount of high, medium, and low priority alarms.</li> <li>c. Power Quality Event Notification – sent regularly to indicate changes in the average amount, duration, and magnitude of Sag, Swell and Transient power disturbances.</li> </ul> <p>14. The Software Platform shall have a web-based Alarm Configuration interface to allow end users to</p>
--	--



	<p>create smart alarms with the following capabilities:</p> <ol style="list-style-type: none"> <li>Realtime Analog and Digital Setpoints with options for time delays and custom alarm labels.</li> <li>Smart Over/Under Setpoints designed specifically for energy (WAGES) and power alarms based on historical average, standard deviation or maximum with options for time ranges, aggregation periods, multipliers and ability to compare specific time periods (Same Hour of Day and/or Same Day of Week).</li> <li>Communication Loss alarms with options for sensitivity and custom alarm labels.</li> <li>Schedules interface for end users to configure when smart software alarms are active or not.</li> </ol>
	<p><b><u>22.4 Software – Data Analytics and Visualization:</u></b></p>
	<ol style="list-style-type: none"> <li>The Software Platform shall include an interactive, web-based Dashboard application that provides auto-updating dashboard views that may contain not only energy and power data but water, air, gas, electric, and steam (WAGES), historical data trends, power quality performance data, images, and content from any accessible URL address.</li> <li>Users shall be able to create, modify, view, and share their dashboards (including graphics, labels, scaling, measurements, date ranges, etc.) using only a browser and without the need for a separate software application to design, create, modify or publish dashboards.</li> <li>The Software Platform shall support kiosk slideshow displays by assigning individual dashboards to slideshows to run in unattended mode, scrolling through designated dashboards at a configurable time interval. <ol style="list-style-type: none"> <li>Any number of kiosk slideshow displays may be created and configured to run independently on any computer using a browser.</li> </ol> </li> <li>The Dashboard application shall provide a library of standard graphical objects (gadgets) including Bar, Pie, Trend, Real Time and Web Portal.</li> <li>The Dashboard application shall provide a library of specialized energy usage graphical objects (gadgets) including Period Over Period Comparison, Pareto Charts, Heat Map / Carpet Plot and Sankey Diagrams.</li> <li>The Dashboard application shall provide a library of specialized Power Quality graphical objects (gadgets) including PQ Downtime Impact, PQ Rating, PQ Incident Breakdown and Location.</li> <li>The Software Platform shall provide an interactive, web-enabled Reports application that allows users to generate, modify, save and manage reports based on pre-formatted report templates (up to 64 templates) that are designed to support the following: <ol style="list-style-type: none"> <li>Energy Cost Allocation and Bill Verification.</li> <li>Energy Usage, Modeling and Performance Verification.</li> <li>Power Quality Performance and Compliance (EN50160 and IEEE 519).</li> <li>Electrical Equipment Operation and Performance (Breakers, UPSs, Generators).</li> </ol> </li> <li>The reporting tool shall support automatic distribution (via email or shared folder) on a schedule</li> </ol>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p>basis or based on event or manual export using the following output formats: .csv, .xlsx, .pdf, .tiff, .html, .xml.</p>
	<p><b><u>22.5 Software – Technical Infrastructure:</u></b></p>
	<p>24. The Software Platform shall be able to be installed on a physical computer or virtual machine and shall support a variety of Windows operating systems including Server and non-Server class Windows operating systems.</p> <p>25. The Software Platform shall support a variety of SQL Server Editions including Enterprise, Standard and Express Editions.</p> <p>26. The Software Platform shall only require SQL Server Database Engine Services and Basic Management Tools and not require the installation of any other additional SQL components such as Analysis Services or Reporting Services.</p> <p>27. The Software Platform shall support the following cybersecurity features:</p> <ul style="list-style-type: none"> <li>a. Encrypt the transmission of data between the Software Platform Server and its Web Clients using Transport Layer Security (TLS) version 1.2.</li> <li>b. Establish secure authentication between the Software Platform Server and its Web Clients using Certification Authority (CA) certificates.</li> <li>c. Encryption and hashing of system credentials using AES256 and SHA-512 respectively.</li> <li>d. Capable of installing into a Federal Information Processing Standard (FIPS) compliant environment.</li> <li>e. Application Whitelisting.</li> </ul> <p>28. The Software platform shall support the integration of Windows Active Directory for users and groups from across multiple domains to facilitate the following:</p> <ul style="list-style-type: none"> <li>a. Login to the Software Platform using Windows credentials.</li> <li>b. Enforce password policies via Windows (complexity and expiration).</li> <li>c. Role-Based Access Control (RBAC).</li> </ul> <p>29. The Software Platform shall intelligently and automatically acquire data from devices, including onboard events, trends and waveforms from natively-supported device types:</p> <ul style="list-style-type: none"> <li>a. Without any need for software configuration or data upload scheduling.</li> <li>b. Onboard, high resolution timestamps (1ms) shall be retrieved without degradation or modification even for devices that support clock synchronization via GPS, IRIG-B, NTP or PTP (Precision Time Protocol).</li> </ul> <p>30. The Software Platform shall support logical device definitions based on inputs/outputs or channels on devices that represent a downstream device with the following features:</p> <ul style="list-style-type: none"> <li>a. Software user interface for device and measurement mapping.</li> <li>b. Bulk-import capability to create large numbers of logical devices without manual single-device configuration.</li> </ul>

31. The Software Platform shall support real-time and historical data aggregation within defined hierarchy views (e.g. Tenants/Racks/Circuits, PDUs/RPPs/Panels, Buildings/Floors/Rooms, or any user defined view) with the following capabilities:
  - a. Web-based, end user interface.
  - b. Automatic and intelligent data aggregation across all nodes in the hierarchy for data visualization in Dashboards, Trends and Reports.
  - c. Creation of virtual devices to enable applications such as net metering, common area allocation and apportionment.
  - d. Update node names and associated time ranges in the hierarchy to properly reflect and accurately report on facility changes (e.g. tenant move in – move out).
  - e. Bulk-import capability to create and edit large hierarchies without manual per-device setup.
32. The Software Platform shall support OPC DA Server 2.01 with the following capabilities:
  - a. Provide default OPC Server tag mappings for all natively supported device types without the need to select, configure, or program the mapping of device registers to OPC tags.
  - b. Provide a flexible means to add or change OPC mappings and shall support the ability to add custom measurements.
33. The Software Platform shall support OPC DA Client 2.01 and come with a built in OPC Test Client.
34. The Software Platform shall support device-level Modbus integration with the following capabilities:
  - a. Modbus master to read/write registers in Modbus devices for monitoring and control applications.
  - b. Support for at least 70 Modbus data formats including 16bit Signed/Unsigned Integers (S16-21, S16-12, U16-21, U16-12, S16-1-15),
35. The Software Platform shall have a single, end user software application specifically designed for integrating Modbus and OPC device types and shall have the following capabilities:
  - a. Simple creation and management of Modbus and OPC device definitions (device drivers) and association of device graphic template screens.
  - b. Pre-defined, default measurement system (Common Data Model) for consistent mapping of Modbus registers and OPC tags to standard measurements.
36. The Software Platform shall support Web Services interoperability with the following capabilities:
  - a. Web Services Server for sharing real-time, historical (i.e. timestamped trend data), and alarm data (i.e. timestamped event strings) from the Software Platform to other Web Services Client applications.
  - b. User interface for Web Services configuration and mapping.
  - c. Provide the ability to acknowledge alarms by authenticated and authorized clients.
37. The Software Platform shall have an Extract, Transform, and Load (ETL) engine for exchanging

	<p>data between files, databases and systems with the following capabilities:</p> <ol style="list-style-type: none"> <li>a. User Interface for specifying connection information, data formats, measurement mappings and schedules.</li> <li>b. Support for importing data from .csv and .xml data files, Wonderware Historian databases and other 3rd party databases via OledB connections.</li> </ol> <p>38. The Software Platform shall support system-wide programs using a graphical, object-oriented application engine capable of logic and arithmetic functions, database queries, XML data import, complex logic-based alarming and data logging, email and text notifications.</p> <p>39. The Software Platform shall remain online (including communications, logging, and alarming) and not require an operator to take the system offline during all system administration functions such as adding, modifying, or removing devices in the system; creating, modifying, or removing graphical diagrams, dashboards, tables, and reports; creating, modifying, or removing application logic programs in the application logic engine.</p> <p>40. The Software Platform shall support offline software configuration management for efficient system deployments and upgrades with a dedicated user interface for creating, copying and deploying software configuration projects.</p> <p>41. The Software Platform shall support internationalization and regional settings.</p> <p>42. The Software Platform shall support the ability to change its default language at any time directly from the web client without the need for any additional installation or advanced software configuration.</p> <p>43. All bidders should consider complete scope of Energy Management system with all the accessories like Software, PC, SQL License, with UPS with one Web view license, Lan cable, Communication Cable, Ethernet Gateway with supply and commissioning of complete project.</p> <p>44. <b>PC Server specification</b> should be as follows:</p> <ul style="list-style-type: none"> <li>· Server PC (Intel Xeon E3-1220v5/ 16GB RAM / 1TB SAS</li> <li>· Monitor: 21.5" TFT LED Back Lit Monitor</li> <li>· Windows Server 2016 Std</li> <li>· Ms-Office 2016</li> <li>· Quick Heal Antivirus for Server PCs for 3 Years</li> </ul> <p>45. SQL Server : Microsoft SQL Database standard version 2014/16/17</p>
<b>23.0</b>	<p><b><u>Operation &amp; Maintenance</u></b></p> <p>Minimum 5 years Operation &amp; Maintenance after DLP period as per tender shall be included in OEM scope. The detailed scope of work shall include yearly testing and authentication of the system. The report of O&amp;M shall be provided as per clients / OEM formats regularly to the facility management team of the client.</p>

<b>24.0</b>	<b><u>INSTALLATION, ERECTION AND TESTING</u></b>
	<p><b><u>POWER CONTROL CENTER / MOTOR CONTROL CENTER, DISTRIBUTION BOARDS</u></b></p> <p><b><u>Erection</u></b></p> <ul style="list-style-type: none"> <li>• Electrical panel shall be delivered in convenient shipping section by the manufacturer. The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. The contractor shall be responsible for final assembly and interconnection of busbars / wiring.</li> <li>• Foundation channel shall be grouted in the flooring by the contractor. Switchgear shall be aligned and levelled on their base channels and bolted to them as per the instructions of the client / consultant. The earth bus shall be made continuous throughout the length.</li> <li>• Loosely supplied relays and instruments shall be mounted and connected on the switchgear. The contacts of the drawout circuit breaker shall be checked for proper alignment and interchange ability.</li> <li>• After erection, the switchboard shall be inspected for dust and vermin proof. Any hole which might allow dust or vermin etc. to enter the panel shall be plugged suitably at no extra cost. If the instrument transformers are supplied separately, they shall be erected as per the direction of the client / consultant. The contractor shall fix the cable glands after drilling the bottom / top plates of all switchboards with suitable holes at no extra cost.</li> <li>• Range of overload relays / timers etc. shall be checked with requirement of motor actually to be connected at site and if the same is undersized / oversized, it shall be brought to the notice of the client / consultant, who shall arrange procurement of corrected components. However, the contractor shall not charge anything extra for labour for such replacements.</li> <li>• Proper procedure shall be carried out to start and test the panel. The panels shall be checked for all electrical parameters and proper earthing shall be done.</li> <li>• All cables shall be dressed properly and shall be terminated from top/bottom as required complete with cable gland and lugs. The gland plate shall be properly closed with required gaskets.</li> <li>• The panels shall be erected on the trench/stand inside room as required.</li> </ul> <p><b><u>4.0 Testing</u></b></p> <ul style="list-style-type: none"> <li>• Before electrical panel is energised, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contacts open.</li> <li>• Before switchgear is energised, the insulation resistance of all control circuits shall be measured from line to ground.</li> <li>• The following tests shall be performed on all circuit breakers during erection.</li> <li>• Contact alignment and wipe shall be checked and adjustment where necessary in accordance with the breaker manufacturer's instructions.</li> <li>• Each circuit breaker shall be drawn out of its cubicles, closed manually and its insulation resistance measured from phase to phase and phase to ground.</li> <li>• All adjustable direct acting trip devices shall be set using values given by the consultant/</li> </ul>

manufacturer.

- The dielectric strength of insulating oil wherever applicable, shall be checked.
- Before switchgear is energised, the following tests shall be performed one each circuit breaker in its test position.
- Close and trip the circuit breaker from its local control switch push button or operating handle. Switchgear control bus may be energised to permit test operation of circuit breaker with A.C. closing with prior permission of the client / consultant.
- Test tripping of the electrically operated circuit breaker by operating mechanical trip device.
- Test proper operation of circuit breakers latch, check carriage limit switch if provided. Test proper operation of lockout device in the closing circuit. Wherever provided by simulating conditions which would cause a lockout to occur.
- Trip breaker either manually or by applying current or voltage to each of its associated protective release.
- Before switchgear is energised, the tests covered above shall be repeated with each breaker in its normal operating position.
- Capacitor banks shall be tested as per manufacturer's instructions. In addition, test for output and/or capacitance, insulation resistance test and test for efficiency of discharge device shall be carried out.
- All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

**Performa For PCC, MCC, DB, Control Panel Test**

- Circuit breaker or contactor module designation / bus no.
- Insulation resistance test (contacts open, breaker racked in position)
  - a) between each phase of bus : Mega ohm
  - b) between each phase and earth : Mega ohm
  - c) DC and AC control and auxiliary circuits : Mega ohm
  - d) between each phase of CT / PT and between  
CT & PT circuit if any : Mega ohm
- CT checks
  - a) CT ratio
  - b) CT secondary resistance
  - c) CT polarity check
- 7. Check for contact alignment and wipe.
- 8. Check / test all releases / relays.
- 9. Check mechanical interlocks.
- 10. Check electrical interlocks.
- 11. Check switchgear / control panel wiring.
- 12. Check breaker / contactor circuit for :

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p>a) Closing - local &amp; remote (wherever applicable)</p> <p>b) Tripping - local &amp; remote (wherever applicable)</p> <p>3. Opening time of breaker / contactor.</p> <p>4. Closing time of breaker / contactor.</p>
--	--

<b>16.0 TECHNICAL SPECIFICATIONS FOR HT OUTDOOR PANEL</b>	
1.0	SCOPE OF WORK
	<p>This specification covers the design, manufacture, testing &amp; supply of H.V outdoor switchboards</p> <p>The enclosed drawings and/ or data sheet, single line diagram form an apart of the specification.</p> <p>The drawing and specifications complement each other and what is shown or called for one shall be interpreted as being called for on both. Material, if any, which may have been omitted but which fairly implied as being required to make a complete assembly of switchgear as shown on the drawing and specifications shall be constructed as being required and no extra charges shall be paid for this material</p>
2.0	DESIGN BASIS & SITE CONDITIONS
	<p>All the equipment and components provided in the switch gear and accessories shall be suitably designed for installation and satisfactory operation as specified below.</p>
3.0	GENERAL REQUIREMENTS
	<p>The scope generally describes to design, manufacture, assemble, connect, wire, supply, test and commission 11KV vacuum circuit breaker outdoor panel.</p> <p>The unit shall consist of tee off spring assisted three position, three pole vacuum circuit breaker.</p> <p>All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification</p> <p>The equipment shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules and regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding</p>
4.0	TECHNICAL REQUIREMENTS GENERAL CONSTRUCTIONAL FEATURES
	<p>The switchgear enclosure shall conform to the degree of protection IP-65. The minimum thickness of sheet steel used shall be 2mm CRCA steel, Base frame &amp; removable gland plate</p>

	<p>shall be 3mm CRCA sheet.</p> <p>The switch gear assembly shall comprise a continuous, dead-front, line-up of free standing, vertical cubicles. Each cubicle shall have a front hinged door with latches and a removable back cover. All covers and doors shall be provided with recessed neoprene gaskets. All doors shall have pad locking arrangement. Switchgear shall be fire retardant type</p> <p>Circuit breakers, instrument transformers, bus-bars, cable compartment etc., shall be housed in totally isolated air tight separate compartments within the cubicle. The design shall be such that failure of one equipment shall not affect the adjacent units. Suitable venting arrangement shall be provided to release the gas pressure developed due to the operation of the breaker or due to live arc of fault</p> <p>Each cubicle shall be separated from adjacent one by grounded sheet steel barrier and bus sealing arrangement.</p> <p>The switchgear panel shall be of arc proof version. Test report as per DIN VDE 0670 part 601, IEC-694/IEC-298 shall be furnished.</p> <p>All relays, meters, switches and lamps shall be flush mounted on the respective cubicle door or on control cabinet built on the front of the cubicle.</p> <p>Each switchgear cubicle shall be provided with a thermostat controlled space heater and single phase plug point operated at 230 V AC. 50 Hz.</p> <p>Each breaker cubicle shall be provided with 'service' and 'test' position limit switches, each having at least 4 NO &amp; 4 NC contacts. All fixing bolts, screws, etc. appearing on the panel shall be so arranged as to present a neat appearance. The swing of the door shall be more than 90 deg C with ip-65.</p>
5.0	<p><b>BUS AND BUS TAPS</b></p> <p>The main buses and connections shall be of high conductivity copper, sized for specified continuous and fault current ratings with maximum temperature limited to 85 deg C (i.e.35 deg C rise over 50deg C ambient)</p> <p>Adequate contact pressure shall be ensured by means of two bolts connection with plain and spring washers and locknuts</p> <p>Bimetallic connectors shall be furnished for connections between dissimilar metals</p> <p>All Busbars, Jumpers and connection shall be fully insulated for working voltage with adequate phase/ground clearances. Epoxy cast-resin shrouds for joints shall be provided. All jointing hardware shall have nylon caps. All busbars, links, jumpers etc. shall be sleeved with sleeves of Raychem/DSG make and non-in flammable heat shrinkable type. Busbars, links, live parts etc. shall have non-flammable shrouds.</p> <p>No paper/cotton based insulation shall be used anywhere in the switch gear.</p>



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p>Minimum amount of combustible and low smoke generation type insulating material shall be used.</p> <p>Safety shutter, phase barrier, busbar seal-off bushing plate, support insulators etc. shall be non-inflammable high tracking fiber glass/epoxy insulation system of grade 94V-O as per UL.</p> <p>All buses and connections shall be supported and braced to withstand dynamic electro-magnetic stresses due to maximum short circuit current and also to take care of any thermal expansion</p> <p>Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from front of the switchgear assembly</p> <p>The successful tenderer shall submit the calculation in support of selection of busbar conductor size, spacing and short time withstand capability</p>
6.0	<p><b>CIRCUIT BREAKERS</b></p> <p>Circuit breaker shall be triple pole, single throw, Vacuum type. Applicable standard shall be IEC-62271-100.</p> <p>Circuit breaker shall be draw out type, having SERVICE, TEST and DISCONNECTED positions with positive indication for each position.</p> <p>Circuit breakers of identical rating shall be physically and electrically interchangeable.</p> <p>Circuit breaker shall have motor wound spring charging facility with Mechanical &amp; Electrical anti-pumping features and shunt trip. In addition facility for manual charging of spring shall be provided. The motor shall be suitable for operation with voltage variation from 85% to 110% of rated voltage. Spring charging motor shall be in a standard enclosure.</p> <p>For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor.</p> <p>Mechanical safety interlock shall be provided to prevent.</p> <p>The circuit breaker from being racked in or out of the service position when the breaker is closed</p> <p>Racking in the circuit breaker unless the control plug is fully engaged.</p> <p>Closing &amp; opening of the breaker in an intermediate position between 'service' &amp; 'test' and between 'Test' and 'Disconnected' position.</p> <p>Automatic safety shutters shall be provided to fully cover the female primary contacts when the breaker is withdrawn from service position.</p> <p>Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indication, an operation counter and mechanism charge/discharge indicator. The manual trip device shall be located on the front door. Indicators with shrouds will be visible from front door even when breaker</p>

is closed.

Suitable padlocking arrangement shall be provided as stated below: Circuit Breaker operating handle in the OFF position.

Each feeder panel operating handle in CLOSED, OPEN, EARTH position.

Each breaker shall be provided with following:

Auxiliary switch, with 4 NO + 4 NC contacts, mounted on the draw out portion of the switchgear

Position/cell switch with minimum 3 NO + 1 NC contacts, one each for TEST and SERVICE position

Auxiliary switch, with 4 NO + 4 NC contacts, mounted on the stationary portion of the switchgear and operated mechanically by a sliding lever from the breaker in SERVICE position

Limit/auxiliary switches shall be convertible type that is facility for changing N.O. contact to N.C. and vice-versa. Switch contact shall be rated 10A A.C. and 2A D.C. at operating voltage

Circuit breaker shall be draw out type, complete with transfer trunks, self-aligning primary and secondary disconnects, positive guides to ensure proper alignment.

Each breaker shall be provided with suitable encased rollers.

The trip coils shall be operated satisfactorily at voltage between 70 % and 110 % of rated control supply voltage.

Each circuit breaker cubicle shall be provided with an earthing facility to earth the incoming or outgoing feeders by the arrangement specified below. Earthing facilities shall be fully interlocked to prevent faulty operation e.g. earthing of live parts.

Separate earthing trunk, which can be inserted in place of circuit breakers, one trunk suitable for incoming and the other for outgoing circuits shall be provided.

Positive earthing of circuit breaker frame shall be maintained when it is in the connected position and in all other positions in which the safety shutters are in open position.

Insulation used for auxiliary switches shall be anti tracking type.

#### INDICATION & MONITORING

Each breaker cubicle shall be equipped with following:

One (1) number heavy duty spring return type TRIP-NORMAL-CLOSE control switch with pistol grip handle

Three (3) indicating lights front of compartments:

GREEN : Breaker Open

RED : Breaker Closed

<p>AMBER : Trip</p> <p>Blue : Spring charged/Low vacuum</p> <p>Lamp shall be LED type with series resistor, Lamp and lens shall be replaceable from the front</p> <p><b>CABLE TERMINATION</b></p> <p>Switchgear shall be designed for cable entry from the top. Sufficient space shall be provided for ease of termination and connection</p> <p>Power cables shall be XLPE insulated, armored, overall PVC sheathed with stranded Aluminum/copper conductor</p> <p>Control cables shall be PVC/XLPE insulated, armored, overall PVC sheathed with</p> <p>2.5mm<sup>2</sup> stranded copper conductor</p> <p>All provisions and accessories shall be furnished for termination and connection of cables, including removable aluminium gland plates, cables supports etc.</p> <p>The gland plates shall be minimum 4mm thick aluminium sheet. The gland plate and supporting arrangement for 1/C power cables shall be such as to minimise flow of eddy current</p> <p><b>GROUND BUS</b></p> <p>A ground bus, rated to carry maximum fault current, shall extend full length of the switchgear</p> <p>The ground bus shall be provided with two-bolt drilling with G.I. bolts and nuts at each end to receive 50 x 6 mm G.I. flat</p> <p>Wherever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independently to the ground bus and connected thereto</p> <p>Suitable ground terminal, directly connected with the ground bus shall be provided in the cable chamber for grounding connection of cable screen/armour</p> <p>All hinged doors shall be grounded using silver plated and braided copper flexible of adequate size</p> <p><b>NAME PLATE</b></p> <p>Nameplates of approved design shall be furnished at front &amp; back side of each cubicle and at each instruments &amp; device mounted on or inside the cubicle</p> <p>The material shall be 3ply lamicaid or approved equal, 3 mm thick with white letter on black background. The letters of the nameplates shall be engraved</p> <p>The nameplate shall be held by self-tapping screws. Nameplate size shall be minimum 20 x 75mm for instrument/device and 40 x 150mm for panels.</p> <p>Caution notice on suitable metal plate shall be affixed at the back of each vertical panel</p>
--

Following plate size & letter size shall be considered for nameplate.

		PLATE SIZE	LETTER SIZE

#### TROPICAL PROTECTION

All equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects & corrosion

Screens of stainless steel shall be furnished on all ventilating louvers to prevent the entrance of insects

#### PAINTING

All surfaces shall be sanding blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease rust and foreign adhering matter.

After cleaning, the surfaces shall be given a phosphate coating followed by 2 coats of high quality primer and staved after each coat.

The switchgear shall be finished in powder coat, shade RAL-7032 MATT finish

Sufficient quantity of touch-up paint (approx. 5 ltrs.) shall be furnished for application at site.

#### ACCESSORIES

Earthing equipment suitable for earthing the bus or outgoing cable

Breaker carrier trolley if C.B. is of that design

Cubicle door opening key (1 for each panel)

Withdrawal handles for breaker

Commissioning spares (Provide list of spares along with offer).

#### 7.0 DESIGN CRITERIA

The Switchgear shall be capable of continuous operation at specified rating under the following condition sec.

Voltage variation : +/- 10 %

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p>Frequency variation : + 3%, -6%</p> <p>Combined voltage &amp; frequency variation : 10 %</p> <p>The de rating of the equipments shall be done taking 50 deg C as an ambient temperature if it is designed at lower temperature. The maximum temp. in any part of the equipment at specified rating shall not exceed 85 deg C considering reference Ambient temperature as 50 deg C.</p> <p>The breakers of the respective system shall have the breaking capacity corresponding to fault levels as specified.</p> <p>The breaker shall be Vacuum type. The circuit breaker shall be fitted with micro processor based self-powered relay inside the front cover.</p> <p>The breaker ratings shall be as per drawing and bill of quantity.</p> <p>The cable termination shall be done by heat shrinkable termination method.</p> <p>The compartment should have sufficient height space for proper Termination/Bonding of cable leads.</p>
8.0	DRAWINGS & INFORMATION
	<p>Drawings, Data &amp; Manuals shall submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of contract and/or elsewhere in the specification for approval &amp; subsequent distribution after the issue of Letter of intent.</p>
9.0	DRAWING AND INFORMATION
	<p>Breaker sizing calculation along with relevant Test Reports.</p> <p>Outline dimensional drawing of the switchgear showing general arrangement, space requirements and cable entry points, busbar chamber, grounding arrangement etc. Bill of Materials.</p> <p>Typical foundation plan.</p> <p>Technical leaflets on &amp; complete specifications &amp; OEM address for bought out items.</p> <p>Bus bar &amp; circuit instruction manuals of switchgear &amp; individual equipment.</p> <p>The manual shall clearly indicate that the installation method, check-up and tests to be carried out before commissioning of the equipment as well as monitoring tests, their interval &amp; maintenance procedures.</p>
10.0	TESTING
	<p>Vendor shall test each cubicle as per relevant standards with all components assembled and fully wired.</p> <p>Routine tests shall be carried out on all components as per relevant standards.</p>

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<p>Four (4) copies of test certificate shall be submitted for Owner's approval before dispatch of switchgear.</p> <p>Vendor shall also submit 4 – sets of Test certificates of all bought out items supplied along with panel, viz.</p> <p>Owner reserves the right to witness the following routine test on switchgear/components mounted in switchgear:-</p> <p>Operational test (Electrical &amp; mechanical) of Circuit Breaker.</p> <p>Pick-up &amp; drop-off voltage test for shunt trip and closing coil.</p> <p>Insulation resistance Test of Power &amp; Control Circuit, before and after High Voltage Test.</p> <p>High Voltage test on Power and Control Circuit</p> <p>Earth continuity test, with low voltage tester.</p> <p>Physical dimensional check as per the approved drawing and visual inspection of the switchgear.</p> <p>Circuit breakers contact opening &amp; closing time at rated voltage, at 70% to 110% of rated voltage and also synchronous operation test.</p> <p>Mili volt drop test of circuit breaker.</p>
11.0	INSPECTION
	<p>Owner or his authorized representatives will carry out inspection including witnessing tests.</p> <p>Vendor shall notify Owner or his authorized representatives in writing at least fifteen (15) days prior to scheduled date of inspection. All apparatus, instruments etc. required for test shall be provided by the vendor's and shall have been checked and tested for accuracy during the twelve month, prior to the test, bearing tag No. of competent authority.</p>
12.0	TRANSPORT, DELIVERY AND STORAGE
	<p>The prices shall be F.O.R. site basis including packing &amp; forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of HT switch gear on site store. The switch gear should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.</p>
	<p>The transportation for any auxiliary item or detachable part of equipment should be simultaneous and carry necessary instructions for assembling and storage requirements.</p>
13.0	COMPLETENESS OF SUPPLY

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	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 conform to highest standard of engineering, design and workmanship
	Any material or accessories which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble free operation and maintenance of the equipment shall be furnished without any extra charge
14.0	<b>GUARENTEE</b>
	The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply. The Purchaser also reserves the right to use the rejected equipment or part thereof until the new equipment meeting the guaranteed performance is supplied by the Bidder.
15.0	<b>MAKE LIST</b>
	Make of switchgear component shall be as specified in data sheet or customer standard or as per specified in BOQ and Make list
16.0	<b>QUALITY ASSURANCE</b>
	Vendor shall submit their internal quality assurance plan followed for manufacturing of the Equipment, for approval of Owner/Consultant. This shall be adhered to and shall be monitored by owner/consultant during manufacture.
17.0	<b>DEVIATION</b>
	Deviation from specification must be stated in writing at the quotation stage. In the absence of such a statement, it will be assumed that the requirements of specification are met without any deviation.
18.0	<b>TOOLS</b>
	One complete set of all special or non-standard tools per set required for installation, operation and maintenance of Circuit Breaker. Vendor shall furnish the list and quote separately.
19.0	<b>SPARES</b>
	The bidder shall quote for minimum spares required for two years safe operation of transformer along with the offer separately. Also OEM to ensure purchase of spare and same part code material for minimum 10 years.
20.0	<b>Operation &amp; Maintenance:</b>
	Minimum 5 years Operation & Maintenance after DLP period as per tender shall be included in OEM scope. The detailed scope of work shall include yearly testing and authentication of the system. The report of O&M shall be provided as per clients / OEM formats regularly to the facility management

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

team of the client.

### **17.0 TECHNICAL SPECIFICATIONS FOR HT XLPE CABLE**

**1.0**

#### **SCOPE OF WORK**

The scope shall cover supplying, laying, testing and commissioning of 3 or 1 core cables of circular stranded aluminum conductors, XLPE extruded dielectric, screened, copper shielded and PVC outer sheathed. The cables will be armoured with galvanized steel armour.

Cables shall be capable of operating at a sustained conductor temperature of 90° c. and suitable for a maximum conductor short-circuits temperature of 250° c.

This specification gives the general requirement of cables. However, it is the responsibility of the vendor to obtain client's approval before the placement of orders to the main supplier/manufacturer.

**2.0**

#### **CODES & STANDARDS**

The following standards and rules shall be applicable :

Sr.	Item	Relevant IS	Relevant IEC
1	Conductors of Insulated Cables	IS: 8130 - 1984	IEC: 228
2	Impulse tests on cables and their accessories		IEC: 230
3	Extruded solid dielectric-insulated power cables for rated voltage from 1 KV upto 30 KV.		IEC: 502
4	Test methods for insulations and sheaths of electric cables and chords.		IEC: 540
5	Test on cable over a sheath which has special protective functions and are applied by extrusion.		IEC: 229
6	Calculations of continuous current rating of cables (100% load factor).		IEC: 287
7	Cross-linked polyethylene insulated PVC sheathed cable for voltage from 3.3 KV upto 33 KV.	IS: 7098 (Part II)	
8	PVC insulation & sheath of electrical cables.	IS: 5831 - 1984	
9	Mild steel wires, formed wires and tapes for armouring of cables.	IS: 3975	



**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

	10	Electrical test methods for electric cables partial discharge test.		IEC: 885(2) - 1987 (Part II)	
3.0	<u>DESIGN BASIS &amp; SITE CONDITIONS</u>				
	All equipment and materials will be selected and rated for use at the following site conditions.				
	Site conditions				
	Location RAJPIPLA MEDICAL CAMPUS		RAJPIPLA- GUJARAT		
	Ambient temperature		Relative humidity		
	Maximum     47 0 C		Maximum     98 %		
	Minimum     5 0 C		Minimum     40 %		
	Design     45 0 C		Design     98 % at 45 0 C		
	Seismic factor     As per IS:1893		RAINFALL 1000 mm/Year		
	Environmental     Non corrosive, Humid and Dusty		Location of Equipment Ground/Air		
	Wind speed     80 kmph maximum				
	Electrical system data :				
	Power supply for Equipment				
	Voltage     11KV ± 5 %		Frequency     50 Hz ± 3 %		
	Permissible combined voltage & frequency variation	± 6 %	System design faults level (Symmetrical)	26.3KA for 1 sec.	
	System earthing LV side neutral solidly earthed		Wiring 3 phase, 3 Wire system on 11Kv system. And 3 phase 4 wire system on 415V		
	Auxiliary power supply				
Power supply	240V AC, 1-Ph, 50Hz or as per specified in SLD				
Control Supply	-----				
Space heater power supply		240V AC, 1-Ph, 50Hz or as per specified in SLD			

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	<b>Illumination power supply</b>	240V AC, 1-Ph, 50Hz or as per specified in SLD
	<b>Plug-socket power supply</b>	240V AC, 1-Ph, 50Hz or as per specified in SLD
<b>4.0</b>	<b><u>TECHNICAL REQUIREMENTS</u></b>	
	<b><u>GENERAL CONSTRUCTIONAL FEATURES</u></b>	
	<b>Conductors:</b> The conductor shall be of circular stranded Aluminium confirming to IS: 8130 & IEC: It shall be clean, reasonably uniform in size & shape smooth & free from harmful defects. Any other form of conductor may also be accepted if in line with modern trends	
	<b>Semi-Conductor Barrier Tape/Tapes:</b> The semi-conducting barrier tape/tapes shall be provided over the conductors.	
	<b>Conductor Screen:</b> The conductor screen shall consist of an extruded layer of thermosetting semi-conducting compound which shall be extruded simultaneously with the core insulation.	
	<b>Insulation:</b> The insulation shall be super clean XLPE compound applied by extrusion and vulcanized to form a compact homogenous body.	
	<b>Insulation Screen:</b> Each insulation have an insulation screen in two parts consisting of: A water barrier tape/Non-metallic semi-conducting swell able tape part and a metallic screen part. The non-metallic part shall be directly applied upon the insulation of each core and may consist of an impregnated but nylon/PVC tape or a similar approved material or, an extruded semi-conducting material extruded simultaneously with the conductor screen and insulation (triple extrusion). The semi-conductor shall be readily strippable and must not be bonded in such a manner that it has to be shaved or scraped to remove. The metallic part shall consist of a copper tape helical applied with a 30% overlap over the water barrier tape/blocking tape. A binder tape of copper shall be applied over the copper wire metallic screen.	
	<b><u>Laying Up:</u></b> The cores shall be identified on the non-metallic part of the insulation screen by legible printing on the length of each conductor or, by the inclusion of a marker tape. The cores shall be laid up with a right hand direction of lay. Binder tape/Moisture barrier: During lay-up, a suitable open spiral binder may be applied, at the manufacturer's discretion, before the application of an extruded inner covering.	
	<b><u>Fillers</u></b> Fillers shall be polypropylene.	
	<b><u>Inner Covering/Sheath</u></b> The inner covering shall be extruded over the laid up cores to form compact and circular bedding for	

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	the metallic layer.
	<b><u>Metallic Layer:</u></b> The metallic layer shall be galvanised steel wire.
	<b><u>Outer Sheath:</u></b> The tough outer sheath, black coloured best resisting PVC polyethylene compound type ST-2 as per IS: 5831 for the operating temperature of the cable shall be provided over the armour as specified in relevant standards by extrusion process.
5.0	<b><u>Cable Marking:</u></b> <b><u>Embossing on outer sheath:</u></b> The PVC outer sheath shall be legibly embossed with the legend: "ELECTRIC CABLE 11000 VOLT" ETC. The letter and figures shall be raised and shall consist of upright block characters. The maximum size of the characters shall be 13 mm. And the minimum size 15% of the cable circumference or 3 mm. whichever be the greater. The gap between the end of one set of embossed characters as above and the beginning of the next shall not exceed 150 mm. <b><u>Identification of Manufacturer and year of manufacture:</u></b> An identification of the manufacturer, year of manufacture, Cable size shall be embossed at regular intervals on the PVC outer sheath. This shall not affect the spacing between repetitions of the legend as given above.
7.0	<b><u>SEALING AND DRUMMING:</u></b> After tests at the manufacturers' works, both ends of the cable shall be sealed to prevent the ingress of moisture during transportation and storage. Cable shall be supplied in lengths of 500 meters non-returnable drums of sufficiently sturdy construction. The spindle hole shall be 110 mm. minimum diameter. Each drum shall bear on the outside flange, legibly and indelibly in the English language, a distinguishing number, the manufacturer's name and particulars of the cable, viz. voltage, length, conductor size, cable type, insulation type and Gross weight shall also be clearly visible. The direction for rolling shall be indicated by an arrow.
8.0	<b><u>DRAWINGS &amp; INFORMATION</u></b> Contractor shall submit the as built drawing of cable laying. Complete technical data sheet and QAP should be submitted after award of contract.
9.0	<b><u>INSPECTION AND TESTING</u></b> Routine tests shall be carried out in accordance with the relevant IEC standards/IS. The copies of routine test results shall be submitted along with each drum length or part thereof.
10.0	<b><u>Method of Measurement</u></b> All the items will be measured as mentioned in Bill of quantity.
11.0	<b><u>TRANSPORT, DELIVERY AND STORAGE</u></b> The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location or site store. The transformer should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	transit insurance. The charges for loading and unloading of equipment's at site should form part of offer.																																																																		
12.0	<p><b><u>GUARANTEE AND WARRENTY</u></b></p> <p>The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply. The Purchaser also reserves the right to use the rejected equipment or part thereof until the new equipment meeting the guaranteed performance is supplied by the Bidder.</p>																																																																		
13.0	<p><b><u>DATA SHEET</u></b></p> <table><tr><th>Sr. No.</th><th>Particulars</th><th>Description</th></tr><tr><td>1.0</td><td>ENVIRONMENT DETAILS</td><td></td></tr><tr><td>1.1</td><td>Ambient Temp In Degree Celsius</td><td>50 Degree Celsius</td></tr><tr><td>1.2</td><td>Ground Temp In Degree Celsius</td><td>35 Degree Celsius</td></tr><tr><td>1.3</td><td>Relative Humidity</td><td>90 % At 35 Degree Celsius</td></tr><tr><td>1.4</td><td>Altitude</td><td>&lt; 1000 Meter Above MSL</td></tr><tr><td>1.5</td><td>Atmosphere</td><td>Non Corrosive, Humid and Dusty</td></tr><tr><td>2.0</td><td>SYSTEM DETAILS</td><td></td></tr><tr><td>2.1</td><td>System Voltage</td><td>11KV , + / - 10%</td></tr><tr><td>2.2</td><td>System Frequency</td><td>50 Hz., +3% / -6%</td></tr><tr><td>2.3</td><td>Grounding</td><td>Solidly Earthed</td></tr><tr><td>2.4</td><td>Fault Level</td><td>For 11 KV System 18.37 KA for 1 Sec</td></tr><tr><td>3.0</td><td>CABLE</td><td></td></tr><tr><td>3.1</td><td>No. of Cores</td><td>3 (Three)</td></tr><tr><td>3.2</td><td>CABLE CONDUCTOR</td><td></td></tr><tr><td>3.2.1</td><td>Size Of Conductor</td><td>As per BOM</td></tr><tr><td>3.2.2</td><td>Material</td><td>High Purity Aluminium</td></tr><tr><td>3.2.3</td><td>Construction</td><td>Stranded</td></tr><tr><td>3.2.4</td><td>Shape</td><td>Compacted Circular</td></tr><tr><td>3.2.5</td><td>Confirming To</td><td>Is-8130</td></tr><tr><td>3.3</td><td>Conductor Screen</td><td>Extruded Semi-conducting Material</td></tr><tr><td>3.4</td><td>CONDUCTOR INSULATION</td><td></td></tr></table>	Sr. No.	Particulars	Description	1.0	ENVIRONMENT DETAILS		1.1	Ambient Temp In Degree Celsius	50 Degree Celsius	1.2	Ground Temp In Degree Celsius	35 Degree Celsius	1.3	Relative Humidity	90 % At 35 Degree Celsius	1.4	Altitude	< 1000 Meter Above MSL	1.5	Atmosphere	Non Corrosive, Humid and Dusty	2.0	SYSTEM DETAILS		2.1	System Voltage	11KV , + / - 10%	2.2	System Frequency	50 Hz., +3% / -6%	2.3	Grounding	Solidly Earthed	2.4	Fault Level	For 11 KV System 18.37 KA for 1 Sec	3.0	CABLE		3.1	No. of Cores	3 (Three)	3.2	CABLE CONDUCTOR		3.2.1	Size Of Conductor	As per BOM	3.2.2	Material	High Purity Aluminium	3.2.3	Construction	Stranded	3.2.4	Shape	Compacted Circular	3.2.5	Confirming To	Is-8130	3.3	Conductor Screen	Extruded Semi-conducting Material	3.4	CONDUCTOR INSULATION	
Sr. No.	Particulars	Description																																																																	
1.0	ENVIRONMENT DETAILS																																																																		
1.1	Ambient Temp In Degree Celsius	50 Degree Celsius																																																																	
1.2	Ground Temp In Degree Celsius	35 Degree Celsius																																																																	
1.3	Relative Humidity	90 % At 35 Degree Celsius																																																																	
1.4	Altitude	< 1000 Meter Above MSL																																																																	
1.5	Atmosphere	Non Corrosive, Humid and Dusty																																																																	
2.0	SYSTEM DETAILS																																																																		
2.1	System Voltage	11KV , + / - 10%																																																																	
2.2	System Frequency	50 Hz., +3% / -6%																																																																	
2.3	Grounding	Solidly Earthed																																																																	
2.4	Fault Level	For 11 KV System 18.37 KA for 1 Sec																																																																	
3.0	CABLE																																																																		
3.1	No. of Cores	3 (Three)																																																																	
3.2	CABLE CONDUCTOR																																																																		
3.2.1	Size Of Conductor	As per BOM																																																																	
3.2.2	Material	High Purity Aluminium																																																																	
3.2.3	Construction	Stranded																																																																	
3.2.4	Shape	Compacted Circular																																																																	
3.2.5	Confirming To	Is-8130																																																																	
3.3	Conductor Screen	Extruded Semi-conducting Material																																																																	
3.4	CONDUCTOR INSULATION																																																																		

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

3.4.1	Material	High Purity Void And Moisture Free Cross Linked
3.4.2	Thickness	> = 5.5mm
3.5	INSULATION SCREEN	EXTRUDED SEMI-CONDUCTING MATERIAL HAVING COPPER TAPE OVER IT
3.6	CORE IDENTIFICATION TAPE	Yes Required
3.7	CORE LAYING	Right Hand Direction
3.8	INNER SHEATH / COVER	Extruded
3.9	ARMOURING	
3.9.1	Material	Flat Steel GI Strip
3.9.2	No Of Strip	4
3.9.3	Size Of Strip	0.8 mm
3.10	OUTER SHEATH	
3.10.1	Material	PVC
3.10.2	Type	St-2 As Per Is-5831-1984
3.10.3	Thickness	> = 1.4 Mm
3.10.4	Colour	Black
3.11	MARKING ON OUTER SHEATH	YES
3.11.1	Voltage Grade	Yes
3.11.2	No. of Cores/Size of Conductor / Material of Conductor	Yes
3.11.3	Type Of Insulation	Yes
3.11.4	Details About Armour	Yes
3.11.5	Details Of Standards	Yes
3.11.6	Year Of Manufacturer	Yes
3.11.7	Any Other Details	Yes
<b>4.0</b>	<b>TESTING</b>	
4.1	Type Test As Per Is	Certificate To Be Provided for each drum
4.2	Routine Test As Per Is	Yes To Be Witnessed By Client
4.3	Acceptance Test	Yes To Be Witnessed By Client
<b>5.0</b>	<b>CABLE DRUM</b>	<b>Non Returnable</b>
5.1	Material	Wooden / Steel

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	5.2	Marking On Cable Drum	As Per Manufacturer's Standard
--	-----	-----------------------	--------------------------------

18.0 TECHNICAL SPECIFICATIONS FOR DISTRIBUTION TRANSFORMER (OIL TYPE)					
1.0		SCOPE OF WORK			
	1.1	This specification are intended to cover engineering, design, manufacture, assembly, testing at manufacturer's works, packing and forwarding, delivery and transportation F.O.R. site of Low loss Transformer complete in all respect with all equipment, fittings and accessories for efficient and trouble-free operation as per the technical specified below			
2.0		CODES & STANDARDS			
	2.1	The design, material, construction, manufacture, inspection, testing and performance of the low loss power transformers shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards and codes of practice.			
	2.2	Transformers shall conform to the current applicable standards and codes of practice as specified as under. In case of conflict between the applicable reference standards and this specification, this specification shall govern.			
			<b>Sr.</b>	<b>Item</b>	<b>Relevant IS</b>
					<b>Relevant IEC</b>
			1	Power transformer	IS 2026
			2	Fittings & Accessories	IS 3639
			3	Climate Proofing	IS 3202
			4	Loading of Transformer	IS 6600
			5	Oil	IS 335
			6	Bushings	IS 20650
			7	Degree of Protection	IS 2147
			8	Testing, Tolerances on guaranteed Particulars	IS 2026
			9	Buchholz Relay	IS 3637
			10	Electrical Insulation	IS 1271
3.0		DESIGN BASIS & SITE CONDITIONS			
	3.1	All the equipment and components provided in the transformer and accessories shall be suitably designed for installation and satisfactory operation as specified below.			
			<b>Site conditions</b>		
			<b>Location</b> : Rajpipla		<b>Site altitude</b> : 36 M above mean sea level
			<b>Ambient temperature</b>		<b>Relative humidity</b>
			Maximum : 50 °C		Maximum : 98 %

# TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

			Minimum : 5 <sup>0</sup> C	Minimum : 40 %
			Design : 45 <sup>0</sup> C	Design 98 % at 45 <sup>0</sup> C
			<b>Seismic factor</b> : Zone III as per IS:1893	<b>Rainfall</b> : 1000 mm/year
			<b>Environmental</b> : Tropical	<b>Location of Equipment</b> : Outdoor
		<b>Electrical system data:</b>		
		<b>Power supply for Equipment</b>		
		Voltage 415 kV ± 5 %		<b>Frequency</b> 50 Hz ± 3 %
		<b>Permissible combined voltage &amp; frequency variation</b>	± 6 %	<b>System design faults level (Symmetrical)</b> 1823 kA for 1 sec. Max.
		<b>System earthing</b> LV side neutral solidly earthed		<b>Wiring</b> 3 phase, 4 wire on 415V system
		<b>Auxiliary power supply :</b>		
		<b>Power supply</b>		240V AC, 1-Ph, 50Hz
		<b>Control Supply</b>		-----
		<b>Space heater power supply</b>		240V AC, 1-Ph, 50Hz
		<b>Illumination power supply</b>		240V AC, 1-Ph, 50Hz
		<b>Plug-socket power supply</b>		240V AC, 1-Ph, 50Hz
<b>4.0</b>		<b>TECHNICAL REQUIREMENTS</b>		
	<b>4.1</b>	<b>GENERAL CONSTRUCTIONAL FEATURES</b>		
	<b>4.1.1</b>	<p>The transformer shall be able to withstand a short circuit between phases and between phase to ground at one side for 5 sec. without damage maintaining rated voltage on the other non-affected side. It shall be capable of withstanding without permanent damage the thermal and dynamic stresses resulting from short-circuit symmetrical R.M.S. and asymmetrical peak currents. Thermal capability shall be sufficient to allow short-circuit current to flow for the specified time without any damage to the equipment.</p> <p>The Bidder shall provide necessary proof to prove the dynamic stability of the transformer proposed to be supplied to withstand the short-circuit either by testing or by submitting the Test Certificates for testing conducted on similar transformer at Government recognised Testing Laboratory (CPRI, ERDA, etc.). The Certificate shall be applicable to the configuration of transformer proposed to be supplied and tested at not less than the circuit fault levels specified on the Data Sheets.</p>		
	<b>4.1.2</b>	Similar parts, particularly removable ones, shall be interchangeable.		
	<b>4.1.3</b>	Pipes and pipe fittings, screws, studs, nuts and bolts used for external connections shall be as per the relevant standards. Bolts and nuts exposed to atmosphere shall be galvanized.		
	<b>4.1.4</b>	Nuts, bolts and pins used inside the transformers and tap changer compartments shall be provided with lock washers or locknuts.		

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	4.1.5	Exposed parts shall not leave pockets where water can collect.
	4.1.6	Internal design of transformer shall ensure that air is not trapped in any location.
	4.1.7	Facility shall be provided for lubrication of bearings and mechanisms.
	4.1.8	Materials in contact with oil shall be such as not to contribute to the formation of acid in oil. Surface in contact with oil shall not be galvanized or cadmium plated.
	4.1.9	Labels shall be provided for all identifiable accessories like relays, switches, fans, current transformers etc. All label plates shall be of non-corrosive material.
	4.1.10	All internal connections and fastenings shall be capable of operating under overloads and over-excitation allowed as per specified standards without injury.
	4.2	PAINTING
	4.2.1	The interior of all transformer tanks and other oil filled chambers and internal structural steel work shall be cleaned of all scale and dust by shot blasting unless otherwise approved. These surfaces shall be painted with not less than two coats of heat resistant, oil insoluble and insulating varnish. Steel surfaces exposed to the weather shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and weather resistant nature, preferably of distinct colour from the prime and finish coats. The final coat shall be of a glossy oil and weather resisting non fading paint of specified shade.
	4.2.2	Metal parts not accessible for painting shall be made of corrosion-resistant material.
	4.2.3	Interior surfaces of mechanism chambers and marshalling kiosks shall receive three coats of paint after proper cleaning. The final coat shall be of a light colour anti-condensation paint.
	4.3	ELECTRICAL AND PERFORMANCE REQUIREMENTS
	4.3.1	Transformers shall operate without injurious heating at the rated kVA at any voltage within +10% to -10 % of the rated voltage of that particular tap.
	4.3.2	Transformers shall be capable of delivering the rated current at a voltage equal to 105 percent of the rated voltage without exceeding the limiting temperature rise.
	4.3.3	Unless otherwise specified, transformers shall be designed for operation at a frequency of 50 Hz.
	4.3.4	The maximum flux density in any part of the core and yokes, at normal voltage and frequency shall be such that the flux density under over voltage conditions shall not exceed the maximum permissible values for the type of core and yoke material used. The type of material and values of flux density in the core/ yoke for the 100%, 125% and 140% and the hysteric characteristic curves shall be included in the Bid, and shall be subject to approval. In case of transformers with variable flux density the voltage variation which affects the flux density at every tap shall be kept in view while designing transformers.



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	4.3.5	<p>Unless otherwise specified, transformers shall be designed for the following over fluxing withstand capability:</p> <ul style="list-style-type: none"> <li>• 110% - Continuous for all transformers.</li> <li>• Transformers shall operate below the knee of the saturation curve at 110 percent voltage to reduce ferro resonance and non-linear oscillations.</li> </ul>
	4.3.6	<p>Unless otherwise stated, transformers shall be capable of operation continuously, in accordance with the applicable standard loading guide at their rated kVA and at any of the specified voltage ratios.</p>
	4.3.7	<p>Overloads shall be allowed within the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, on-load tap changers or other auxiliary equipment shall apply.</p> <ol style="list-style-type: none"> <li>1. Transformer core shall be built up of low loss non-ageing, cold rolled grain oriented silicon steel insulated laminations. Adequate cooling ducts shall be provided. Transformer tanks shall be of robust construction fabricated out of M.S. plate. All welded joints and valves shall be tested after fabrication of the tank to withstand up pressure of 1.0 kg/sq.cm. in excess of the static head of oil. Bolted joints shall carry non-deteriorating -gaskets.</li> <li>2. Transformer cooling shall be as specified under equipment schedule with fixed or removable radiator tubes of seamless construction and adequately braced to the tank.</li> <li>3. All normal fittings required under section 14 of IS: 2026 - Part I shall be provided. Additional fittings shall also be provided as stipulated in the Datasheet.</li> <li>4. The transformer shall be supplied with oil conforming to IS: 335. The transformer shall be delivered after drying out and ready to put into commissioning without further drying out at site.</li> <li>5. The thermal ability to withstand short circuit shall be demonstrated by the calculations.</li> <li>6. The dynamic ability to withstand short circuit shall be demonstrated by reference to tests on similar transformers.</li> <li>7. Every care shall be taken to ensure that the design and manufacture of all transformers shall be such as to reduce noise and vibration to the level obtained in good modern practice.</li> <li>8. The transformers shall be designed with particular attention to the suppression of harmonic voltage, especially the third and fifth, so as to eliminate wave form distortion and from any possibility of high frequency disturbances reaching such a magnitude as to cause interference with communication circuits.</li> <li>9. All rated quantities subject to the guarantees shall be within the tolerances given in applicable standards.</li> <li>10. The finally assembled core with all the clamping structures shall be free from deformation and shall not vibrate during operation.</li> <li>11. All internal metal parts of the transformer, with the exception of individual laminations, core bolts and their individual laminations, core bolts and their individual clamping plates shall be earthen.</li> </ol>

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

		<p>12. Windings shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service. Adjustable devices shall be provided for taking up possible shrinkage in service.</p> <p>13. Materials used in the insulation and assembly of the windings shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil, and shall not soften or be otherwise affected under the operating conditions.</p> <p>14. The completed core and coil assembly shall be dried in vacuum at not more than 0.5 mm of mercury absolute pressure and shall be immediately impregnated with oil after the drying process to ensure the elimination of air and moisture within the insulation. Vacuum may be applied in either vacuum oven tank or in the transformer tank.</p>
	4.4	<b>VALVES</b>
	4.4.1	Valves shall be of forged carbon steel upto 50 mm size and of gun-metal or of cast iron bodies with gun-metal fittings for sizes above 50 mm. They shall be of full-way type with screwed ends and shall be opened by turning counter clockwise when facing the hand wheel. There shall be no oil leakage when the valves are in closed position.
	4.4.2	Every valve shall be provided with an indicator to show the open and closed positions and shall be provided with facility for padlocking in either open or closed position. All screwed valves shall be furnished with pipe plugs for protection.
	4.4.3	All valves shall be provided with flanges having machined faces drilled to suit the applicable requirements. Oil- tight blank flanges shall be provided for each connection for use when any radiator is detached and for all valves opening to atmosphere. If any special radiator valve tools are required, the same shall be provided.
	4.5	<b>TRANSFORMER COOLING EQUIPMENT</b>
	4.5.1	Radiators and coolers shall be designed to withstand the vacuum and pressure conditions specified for the tank. They shall be so designed as to avoid pockets in which moisture may collect, to completely drain oil into the tank and to prevent formation of gas pockets when the tank is being filled.
	4.5.2	The clearance between all pipe work and live parts shall be more than the clearance for live parts to earth.
	4.5.3	Unless otherwise approved, for transformers rated 1000 kVA and above, tank mounted radiators/coolers shall be of the detachable type with bolted and gasketed flanged connections.
	4.6	<b>TAPS AND TAP CHANGE GEAR:</b>
	4.6.1	Tapings shall be On Load/Off Load (where ever applicable as mentioned in data sheets) and brought out from HV winding and terminated in an external motor operated tap switch with position indicator. Transformer output shall remain unaffected for any tap position.

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

	<b>4.7</b>	<b>ON LOAD TAP CHANGE GEAR:-</b>
	<b>4.7.1</b>	The tap changers shall be of ON circuit type mechanically rugged and arranged to provide for convenient inspection and maintenance without necessity for un-tanking. The position indicators shall be positive and there shall not be any ambiguity resulting into incomplete tap change with respect to the mechanical tap position indication. The operating handle of tap exchanger shall be brought out of the tank at the side at an accessible height from ground level. Tap changer operating switch mounted on the top of the transformer tanks will not be acceptable. Provision of padlocking the tap changers without interfering with visual tap position indicator shall be provided.
	<b>4.7.2</b>	The main current carrying fixed and moving contacts shall be made of copper. The contacts performing making and breaking of current shall be of copper-tungsten to prevent contact erosion due to arcing.  The compartment housing the assembly of selector switch shall be filled with the transformer oil.
	<b>4.7.3</b>	The driving mechanism of OLTC shall comply with all the following requirements.  Stored energy spring device with positive snap action for rotating moving contacts, and spring carrying gear wheel to be rotated by a motor through a reduction gear, i.e. stored energy type mechanism.  Ability of motor to drive the mechanism for tap changing in the event of failure of stored energy spring device.  Facility for manual hand driving of mechanism.
	<b>4.7.4</b>	The drive mechanism shall ensure positive operation of the selector switch by its dependence only on quick release of the stored energy by the spring and shall be independent of the motorized drive.  In order to prevent over-running of OLTC, the limit switches for both directions and mechanical type stop shall be provided.
	<b>4.7.5</b>	OLTC tap changing driving mechanism motor shall be of squirrel cage totally enclosed type and shall comply with the specified Indian Standard. The motor shall be suitable for 415V, 3-ph, 50 Hz power supply and starting direct on line. The motor shall be designed to continuously operate at any frequency between 48 to 50 Hz in both directions. The motor shall have bearings capable of withstanding thrust due to the weight of the moving parts.  RTCC Panel to be provide for control and remote operation with automatic voltage regulator.
	<b>4.7.6</b>	Features for OLTC  Following items shall be provided for OLTC :  - High Torque Electric motor suitable for 415 Voltas, 3 phase, 50 Hz AC supply.

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

		<ul style="list-style-type: none"> <li>- Motor drive and energy accumulator</li> <li>- Motor isolating device with over load protection</li> <li>- Contactors for forward and reverse operation of motor</li> <li>- 'Raise/Lower' control for local &amp; remote operation.</li> <li>- 'Raise/Lower' Limit switch.</li> <li>- Interlock between manual &amp; electrical operation.</li> <li>- Auxiliary contacts</li> <li>- Retainer Switch</li> <li>- Tap Position Indicator</li> <li>- Tap operation counter</li> <li>- Stoppers to prevent over travelling of mechanism</li> <li>- Internal illuminating lamp with switch.</li> <li>- 'Local/Remote' control selector switch.</li> <li>- Auto/Manual selector switch.</li> <li>- Anti-condensation heater with switch and thermostat</li> <li>- Handle for manual operation.</li> <li>- Driving Mechanism chamber locking arrangement.</li> <li>- Terminal Strips</li> <li>- Lubricating Chart</li> <li>- Undrilled gland plate for cable entry.</li> </ul> <p><b>C.</b> The following shall be required for remote indicating. :</p> <ul style="list-style-type: none"> <li>- Potentio meter for remote tap position indicator</li> <li>- Contacts for Tap change in progress indication.</li> <li>- Contacts for Upper and Lower limit reached indication.</li> <li>- Contacts for Tap change stuck / incomplete indication.</li> </ul>
	4.7.7	<p><b><u>Remote Tap Changer Control Panel (RTCC)</u></b></p> <p>RTCC panel shall be of sheet steel cabinet for indoor installation (IP 52), floor mounting type. The RTCC panel shall be totally enclosed, completely dust and</p>

		<p>vermin proof and shall be with hinged doors, Neoprene gasket and padlocking arrangement. RTCC panel shall be suitable for the climatic conditions as specified in Special Conditions. Steel sheets used in the construction of RTCC panel shall be 14 SWG CRCA sheet steel and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to IS-8623-1977 (part-I) for factory built assembled switchgear &amp; control gear for voltage upto and including 1100 V AC</p> <p>All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self-threading screws shall not be used in the construction of RTCC panel. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panel.</p> <p>The following components shall be provided in the RTCC panel :</p> <ul style="list-style-type: none"> <li>- Digital Tap Position Indicating Meter</li> <li>- Raise/Lower Push Buttons for Remote Control of OLTC</li> <li>- Tap Change in Progress Signal Lamp.</li> <li>- Supply on Signal Lamp</li> <li>- Local / Remote Control Indicating Lamps</li> <li>- Panel illuminating lamp with door switch.</li> <li>- Space Heater with Switch and Thermostat.</li> <li>- Automatic Voltage Relay with Time Delay Element.</li> <li>- Selectors switch for Auto/Manual Operation.</li> <li>- Undrilled Gland Plate for Cable entry.</li> <li>- Earthing Terminal</li> <li>- Lifting Eyes Bolts.</li> </ul> <p>The following Item's Status require in BMS and necessary provision require from Transformer Vendor</p> <ul style="list-style-type: none"> <li>- Buchholz Alarm</li> <li>- Buchholz Trip</li> <li>- Oil temperature High / Low</li> <li>- Winding temperature High / Low</li> </ul>
--	--	---

# TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

		<div>- Magnetic oil level gauge</div> <div>- Oil surge relay</div>																																																																																																																								
4.8	LOSSES																																																																																																																									
4.8.1	The iron losses and copper losses shall be as mentioned in data sheet.																																																																																																																									
4.8.2	Bids will be evaluated based on the CBIP formula.																																																																																																																									
4.8.3	<div>For the purpose of evaluation of Bids, the quoted load losses and iron losses shall be increased to take into consideration tolerance as permitted by applicable standards and as quoted.</div> <div>Table 6 Maximum Total Losses Up to 11 kV Class Transformer (Clause 7.8.1.1)</div> <table><tr><th rowspan="3">Sl No.</th><th rowspan="3">Rating (kVA)</th><th rowspan="3">Impedance (Percent)</th><th colspan="6">Maximum Total Loss (W)</th></tr><tr><th colspan="2">Energy Efficiency Level 1</th><th colspan="2">Energy Efficiency Level 2</th><th colspan="2">Energy Efficiency Level 3</th></tr><tr><th>50% Load</th><th>100% Load</th><th>50% Load</th><th>100% Load</th><th>50% Load</th><th>100% Load</th></tr><tr><th>(1)</th><th>(2)</th><th>(3)</th><th>(4)</th><th>(5)</th><th>(6)</th><th>(7)</th><th>(8)</th><th>(9)</th></tr><tr><td>i)</td><td>250</td><td>4.50</td><td>1 050</td><td>2 150</td><td>980</td><td>2 930</td><td>920</td><td>2 700</td></tr><tr><td>ii)</td><td>315</td><td>4.50</td><td>1 100</td><td>2 275</td><td>1 025</td><td>3 100</td><td>955</td><td>2 750</td></tr><tr><td>iii)</td><td>400</td><td>4.50</td><td>1 300</td><td>3 075</td><td>1 225</td><td>3 450</td><td>1 150</td><td>3 330</td></tr><tr><td>iv)</td><td>500</td><td>4.50</td><td>1 600</td><td>4 750</td><td>1 510</td><td>4 300</td><td>1 430</td><td>4 100</td></tr><tr><td>v)</td><td>630</td><td>4.50</td><td>2 000</td><td>5 855</td><td>1 860</td><td>5 300</td><td>1 745</td><td>4 850</td></tr><tr><td>vi)</td><td>1 000</td><td>5.00</td><td>3 000</td><td>9 000</td><td>2 790</td><td>7 700</td><td>2 620</td><td>7 000</td></tr><tr><td>vii)</td><td>1 250</td><td>5.00</td><td>3 600</td><td>10 750</td><td>3 300</td><td>9 200</td><td>3 220</td><td>8 400</td></tr><tr><td>viii)</td><td>1 600</td><td>6.25</td><td>4 300</td><td>13 500</td><td>4 200</td><td>11 800</td><td>3 970</td><td>11 300</td></tr><tr><td>ix)</td><td>2 000</td><td>6.25</td><td>5 400</td><td>17 000</td><td>5 050</td><td>15 000</td><td>4 790</td><td>14 100</td></tr><tr><td>x)</td><td>2 500</td><td>6.25</td><td>6 500</td><td>20 000</td><td>6 150</td><td>18 500</td><td>5 900</td><td>17 500</td></tr></table>	Sl No.	Rating (kVA)	Impedance (Percent)	Maximum Total Loss (W)						Energy Efficiency Level 1		Energy Efficiency Level 2		Energy Efficiency Level 3		50% Load	100% Load	50% Load	100% Load	50% Load	100% Load	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	i)	250	4.50	1 050	2 150	980	2 930	920	2 700	ii)	315	4.50	1 100	2 275	1 025	3 100	955	2 750	iii)	400	4.50	1 300	3 075	1 225	3 450	1 150	3 330	iv)	500	4.50	1 600	4 750	1 510	4 300	1 430	4 100	v)	630	4.50	2 000	5 855	1 860	5 300	1 745	4 850	vi)	1 000	5.00	3 000	9 000	2 790	7 700	2 620	7 000	vii)	1 250	5.00	3 600	10 750	3 300	9 200	3 220	8 400	viii)	1 600	6.25	4 300	13 500	4 200	11 800	3 970	11 300	ix)	2 000	6.25	5 400	17 000	5 050	15 000	4 790	14 100	x)	2 500	6.25	6 500	20 000	6 150	18 500	5 900	17 500	
Sl No.	Rating (kVA)				Impedance (Percent)	Maximum Total Loss (W)																																																																																																																				
						Energy Efficiency Level 1		Energy Efficiency Level 2		Energy Efficiency Level 3																																																																																																																
		50% Load	100% Load	50% Load		100% Load	50% Load	100% Load																																																																																																																		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)																																																																																																																		
i)	250	4.50	1 050	2 150	980	2 930	920	2 700																																																																																																																		
ii)	315	4.50	1 100	2 275	1 025	3 100	955	2 750																																																																																																																		
iii)	400	4.50	1 300	3 075	1 225	3 450	1 150	3 330																																																																																																																		
iv)	500	4.50	1 600	4 750	1 510	4 300	1 430	4 100																																																																																																																		
v)	630	4.50	2 000	5 855	1 860	5 300	1 745	4 850																																																																																																																		
vi)	1 000	5.00	3 000	9 000	2 790	7 700	2 620	7 000																																																																																																																		
vii)	1 250	5.00	3 600	10 750	3 300	9 200	3 220	8 400																																																																																																																		
viii)	1 600	6.25	4 300	13 500	4 200	11 800	3 970	11 300																																																																																																																		
ix)	2 000	6.25	5 400	17 000	5 050	15 000	4 790	14 100																																																																																																																		
x)	2 500	6.25	6 500	20 000	6 150	18 500	5 900	17 500																																																																																																																		
		<div>In case of non-achievability of the losses at the time of testing, the contractor shall be penalized at the rate of per KW if not as per the standards.</div> <div>Energy efficient level 3 to be provided as per latest amendment for IS 1180.</div>																																																																																																																								
4.9	REJECTION																																																																																																																									
4.9.1	<div>The client may reject any transformer if during tests or service any of the following conditions arise:</div> <div><div>1. No load loss exceeds the guaranteed value by 20% or more.</div><div>2. Load loss exceeds the guaranteed value by 20% or more.</div><div>3. Impedance value exceeds the guaranteed value by + or - 10% or more.</div><div>4. The difference in impedance values of any two phases during single phase short circuit impedance test exceeds 2 percent of the average value guaranteed by the BIDDER.</div><div>5. Oil or winding temperature rise exceeds the specified value by 5 Deg.Cent.</div><div>6. Transformer fails on impulse test.</div><div>7. Transformer fails on power frequency voltage withstand test.</div><div>8. Transformer is proved to have been manufactured not in accordance with agreed</div></div>																																																																																																																									

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

		specification.
	4.9.2	The client reserves the right to retain the rejected transformer and take it into service until the BIDDER replace, at no extra cost, the defective transformer by a new transformer. Alternatively, the BIDDER shall repair or the replace the transformer within a reasonable period to the client satisfaction at no extra cost.
<b>5.0</b>		<b>DRAWINGS &amp; INFORMATION</b>
	5.1	ALONGWITH OFFER
	5.1.1	The bidder shall submit completely filled data sheet as per the given format along with GA drawing indicating list of accessories.  Submit list of spare parts required for safe operation of equipment for Two years.
	5.2	HANDING OVER DOCUMENTS
	5.2.1	The supplier shall submit following:  6. GA drawing 7. HV/LV Cable Box 8. Foundation layout 9. Rating and Diagram Plate 10. Data sheet indicating results of tests 11. Test reports 12. O & M manuals
<b>6.0</b>		<b>INSPECTION AND TESTING</b>
	6.1	Following tests should be preformed as acceptance test at <b>manufacturing place</b> ,  1. Measurement of windingresistance at all taps 2. Measurement of voltage ratio and check' of voltage vector relationship 3. Measurement of impedance volt age/short-circuit impedance(principal tapping) and load loss 4. Measurement of no-load loss and current 5. Measurement of insulation resistance 6. BDV of insulating oil 7. Tests on on-load tap-changers 8. Magnetic balance test 9. Functioning of equipments at marshalling box 10. Submission of test reports and certificates for all the bought out components from the sub-suppliers for the tests carried out at the respective manufacturer's works

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

		<p>11. Calibration reports of meters used during testing</p> <p>12. Any other special test, if asked for in data sheet</p>
<b>7.0</b>		<b>METHOD OF MEASUREMENT</b>
	7.1	Supply of the transformer including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.
<b>8.0</b>		<b>TRANSPORT, DELIVERY AND STORAGE</b>
	8.1	The prices shall be <b>F.O.R. site basis</b> including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of transformer or site store. The transformer should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including <b>transit insurance</b> . The charges for loading and unloading of equipments at site should form part of offer.
	8.2	The transportation for any auxiliary item or detachable part of equipment should be simultaneous and carry necessary instructions for assembling and storage requirements.
	8.3	The transformers and all associated oil-filled equipment shall generally be supplied completely filled with the oil along <b>with 10% excess quantity of oil</b> in the sealed non-returnable drums. The oil shall be new conforming to IS: 335 and shall be free from moisture and other impurities harmful to the transformer and shall have uniform quality throughout.
<b>9.0</b>		<b>GUARANTEE AND WARRANTY</b>
	9.1	The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply. The Purchaser also reserves the right to use the rejected equipment or part thereof until the new equipment meeting the guaranteed performance is supplied by the Bidder.
<b>10.0</b>		<b>SPARES</b>
	10.1	The bidder shall quote for minimum spares required for two years safe operation of transformer along with the offer separately.
<b>11.0</b>		<b>ATTACHMENTS</b>
	11.1	<ul style="list-style-type: none"> <li>Data sheet</li> </ul>

### 18.A TECHNICAL SPECIFICATIONS FOR INSTALLATION OF DISTRIBUTION TRANSFORMER (OIL TYPE)



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>1.0</b>		<b>SCOPE</b>
	1.1	This specifications intended to cover assembly, installation and testing of Transformer complete in all respect with all equipment, fittings and accessories for efficient and trouble-free operation. The material to be supplied by the Contractor and work to be carried out by the Contractor shall be in general, but not limited to, conforming to the specification laid down for each item.
<b>2.0</b>		<b>CODES &amp; STANDARDS</b>
	2.1	<p>Following Indian Standards and Code of Practice shall be applicable to the work of erection and commissioning of the transformer.</p> <ul style="list-style-type: none"> <li>i. IS: 2027 Specification for Power and Distribution Transformers</li> <li>ii. IS: 1886 Code of Practice for Installation and Maintenance of Transformers</li> <li>iii. IS:335 Specification for New Insulating Oil</li> <li>iv. IS: 10028 Drying out of the Transformer</li> </ul>
<b>3.0</b>		<b>MATERIALS REQUIRED</b>
	3.1	All required hardware such as bolts, nuts, washers (round and spring type), anchor fasteners, screws, etc. of sizes and type as required shall be conforming to relevant IS. All hardware shall be hot-dip galvanized or zinc passivated/cadmium plated as per requirement of work either mechanical fabrication or electrical jointing.
	3.2	Equipment Grouting material such as cement, metal, sand, bricks, etc., if required, shall be supplied by the Contractor. The material shall be of approved make (Wherever applicable) for which the Contractor shall consult Engineer-in-charge before procuring the material.
<b>4.0</b>		<b>INSTALLATION OF SYSTEM</b>
	4.1	The transformer shall be correctly positioned on channel over constructed concrete foundation. Leveling shall be checked and the transformer shall be aligned and checked for free movement over channels or rails. Stoppers shall be clamped to the transformer thereafter to prevent any movement.
	4.2	In case, accessories like Buchholz relay, valves, explosion vent, silica-gel breather, etc. loose, all such items shall be checked for any transit damage. These accessories shall be thoroughly cleaned and correctly installed on the transformer.
	4.3	The transformer tank shall be filled up with oil, however, some oil top up, if required, shall be done, adopting correct oil filling and topping practice. It shall be ensured that all radiators, valves, gauges, etc. are installed before oil is filled up. Oil shall be tested for dielectric strength before filling.
	4.4	Wiring of devices such as Buchholz relay, Dial thermometers, etc. shall be carried out up to the marshalling box in case these items shall be supplied loose.
	4.5	The devices such as Buchholz relay, OSR, WTI, OTI, ETPB etc. shall be checked for their

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

		operation of alarm/trip contacts by simulation.
	4.6	After erection of transformer, touch up paint shall be applied, wherever required.
	4.7	Connection of neutral with correct earthing station and transformer body, cable termination chamber, bus termination chamber, marshalling box, etc. shall be carried out as mentioned elsewhere in the inquiry document. Earth contact between tank and top plate, radiators, etc. shall be established by providing GI flats or such connection, if not done by the manufacturer.
	4.8	The transformer should be charged after carrying out required tests as per IS and as specified in clause "Inspection and Testing". The test reports should be submitted to Client / Consultants prior to charging.
<b>5.0</b>		<b>EARTHING INSTALLATION</b>
	5.1	The earth system shall generally cover the following.  a. Equipment earthing for personnel and equipment safety.  b. System neutral earthing.
	5.2	Following equipment and systems shall be provided for earthing connection.  a. System neutrals at two distinct earthing stations.  b. Metallic non-current carrying parts of all electrical equipment such as transformer, operating handle, 11 kV Switchboard, LV Switchboard, etc.  c. Cable trays, racks.  d. Fence and Gate of transformer yard.  e. Lightning arrestors installed on 2-pole structure.  f. Cable shields and armour.
	5.3	Civil construction material such as cement, sand, metal, bricks, etc. for construction of brick chamber for earthing station shall be supplied by the Contractor.
	5.4	Minimum 3000 mm spacing between adjacent earthing stations shall be maintained unless stipulated otherwise. Minimum distance of pit from the boundary of building shall be 1000 mm.
	5.5	The installation of earthing stations shall be strictly as per the drawing provided in the layout approved by the Electrical Inspector. Location of pits for earthing stations shall be decided such that fouling with surrounding equipment, foundations, structures, pipelines, etc. is avoided.
	5.6	Earthing station designation shall be painted on top of CI cover of the pit. Further on bottom of the cover, the earthing station identification with earth resistance value and date of testing shall be painted.

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	5.7	Individual earthing station and earth electrode shall be provided with facility for disconnection to check its earth resistance periodically.
	5.8	Excess earth after backfilling shall be disposed off at location shown by the Client, which shall be within the company premises.
	5.9	Interconnection between earthing stations shall be strictly 600 mm below finished ground level.
<b>6.0</b>		<b>INSPECTION &amp; TESTING</b>
	6.1	<p>List of tests to be carried out <b>at site</b> in presence of Client/Consultant's representative :</p> <ol style="list-style-type: none"> <li>1. Measurement of BDV for transformer oil</li> <li>2. Insulation Resistance test</li> <li>3. Vector group test</li> <li>4. Magnetic balance test</li> <li>5. Winding Resistance test</li> <li>6. WTI/OTI alarm &amp; Trip confirmation</li> <li>7. Transformer oil filtration (if required)</li> <li>8. OSR, PRV trip confirmation</li> </ol> <p>Test reports should be submitted to Client/Consultants in duplicate.</p>
<b>7.0</b>		<b>METHOD OF MEASUREMENT</b>
	7.1	Installation of the transformer including site testing and charging of transformer as specified will be treated as one unit for measurement and payment.

### OIL TYPE TRANSFORMER DATA SHEET.

SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
<b>1.0</b>	<b>GENERAL FEATURES</b>		
1.1	Make		
1.2	Installation	Outdoor	
1.3	Service	Continuous	
1.4	Climate	Tropical, dusty, Humid	
1.5	Type of cooling	ONAN	

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

<b>SR.</b>	<b>PARTICULAR</b>	<b>DETAILS</b>	<b>DATA TO BE FILLED BY THE BIDDER</b>
1.7	Allowable temperature rise	Oil - 50 deg.c. Winding - 55 deg.c.	
1.8	Painting	Epoxy, shade no. 631 as per IS: 5	
1.9	Oil type	Mineral oil	
1.10	Position	Plinth mounted	
<b>2.0</b>	<b>ELECTRICAL DATA:</b>		
2.1	Earthing:  L.V. side	Solid	
2.2	No. of windings	Two	
2.3	Phase	3	
2.4	Frequency	50 Hz.	
2.5	Voltage ratio	11/0.433 V	
2.6	Phase connection	Delta – Star	
2.7	Vector group	Dyn – 11	
2.8	% impedance	8% without IS tolerance	
2.9	Rating in KVA	1 Nos. 1250 kVA	
2.10	Winding insulation class	"A"	
2.11	Terminations:	Cable box	
a)	H.V. side	Disconnecting Type cable box with rain protected system at Horizontal/Vertical joints.  Size: 1 No., 3 c x 240 mm. <sup>2</sup> AL HT XLPE (E) CABLE.	
b)	L.V. side	CABLE – 6 Nos of 300 sq mm	
2.12	HV & LV separation:	180 Degree	

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

<b>SR.</b>	<b>PARTICULAR</b>	<b>DETAILS</b>	<b>DATA TO BE FILLED BY THE BIDDER</b>
<b>3.0</b>	<b>TAP CHANGER:</b>		
3.1	Tapings	H.V.	
3.2	Tap changer	ON load	
3.3	Tapping range	-10 % to +10%(1250KVA)	
3.4	No. of steps	in steps of 2.5%	
<b>4.0</b>	<b>Limit for transformer operation under over load condition as per IS</b>	Required	
<b>5.0</b>	<b>ACCESSORIES:</b>		
	Double float Buchholz relay with alarm & trip contacts Marshalling box Sampling valve Plain oil level gauge Conservator & conservator drain valve Bidirectional rollers Oil temp. indicator with alarm & trip contacts Bottom drain/Filter valve Double diaphragm Explosion vent Silica-gel breather Air release plug	Required	

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
	Separate neutral bushing Top oil filter valve Jacking pads Lifting lug Earthing terminal 1 set of detachable radiator with shutoff valve Winding temp. indicator with alarm & trip contacts Rating and diagram plate HV & LV gland plate	Required	
<b>6.0</b>	<b>PERFORMANCE DATA:</b>		
6.1	Rated guaranteed losses without IS tolerance		
a)	No load at 100% voltage	Required	
b)	Full load Cu. Loss	Required	
6.2	Rated No load current	Required	
a)	No load at 100% voltage		
6.3	Rated efficiency at 0.8 P.F.	Required	
a)	At full load		
b)	At 75% load		
c)	At 50% load		
6.4	Rated regulation	Required	
a)	At 0.9 P.F. lag		
b)	At 0.8 P.F. lag		
c)	At unity P.F.		
6.5	Impedance voltage	Required	
a)	Primary – Secondary		
6.6	Load at which max. efficiency occurs	Required	
6.7	Maximum efficiency	Required	
6.8	Maximum flux density	Required	
6.9	Current density	Required	
<b>7.0</b>	<b>MECHANICAL DATA:</b>	Required	
7.1	Weight:	Required	
a)	Core & windings		

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
7.2	Dimensions (mm.): (Dimensions should be considered including all accessories)	Required	

**19.0 TECHNICAL SPECIFICATIONS FOR LT BUSDUCTS**

<b>1.0</b>	<b><u>Specifications of Busduct:</u></b>
	<p>This specification covers the requirements of manufacture, assembly, inspection, testing and delivery of metal enclosed three phase / three phase neutral busbar.</p> <p>a) The busbar trunking system feeder shall be sandwich construction. All busbar trunking products and fittings (straight length, elbow, tees, flanged ends, cable tap box and circuit breaker, etc.) shall be in accordance with IEC 61439 Part 6 (2012) or UL857 and from the same manufacturer as the busbar trunking system. The degree of protection of the busbar trunking system should be IP54 for indoor and IP54 + canopy for outdoor in accordance to IEC 60529.</p> <p>b) Rated operation voltage of the busbar trunking is 1000V. 3 – Phase, 4 Wire rated at 50% capacity continual integral earth, factory fitted and factory tested earthing, withstand capacity of earth should be part of type test certificate. Earthing should be integral part of busduct. The neutral conductor should have the same cross-sectional area as the phase conductor. The earth busbar must be one continuous piece without bolting on housing &amp; External busbar should not be used.</p> <p>c) The ampere ratings, approximate footage, fitting, plug-in units etc. are shown on the plan. The electrical contractor shall be responsible for routing the busbar trunking to coordinate with the other trades. Final field measurements shall be made by the contractor prior to release to the busbar trunking for fabrication by the manufacturer.</p> <p>d) The measurement of total length for the busway will be made end to end: Straight Lengths + Connections + Elbows + Flanged ends.</p> <p><b>Certificate:</b></p> <p>a) The busbar, of full range and each rating, should pass full type tests specified in IEC 61439</p>

Part 6 (2012) The certificate shall be issued by an international independent testing authority (e.g. ASTA, KEMA, UL).

b) Vendor to submit the test certificates of following mandatory tests as per IEC 61429-6:2012

**Type tests FOR BUSDUCT:**

- Strength of material and parts 10.2
- Degree of protection of enclosures 10.3
- Protection against shock & integrity of protective circuits 10.5
- Incorporation of switching devices and components 10.6
- Internal electrical circuits and connections 10.7
- Terminals for external conductors 10.8
- Dielectric properties 10.9
- Power-frequency withstand voltage 10.9.2
- Impulse withstand voltage 10.9.3
- Temperature-rise limits 10.1
- Short-circuit withstand strength 10.11
- Electromagnetic compatibility (EMC) 10.12
- Mechanical operation 10.13
- Resistance to flame propagation 10.101
- Fire resistance in building penetration 10.102

A product safety mark (e.g. KEMA-KEUR, ASTA DIAMOND) should be on the product offering a visible assurance to full product safety testing, factory inspection and ongoing surveillance under independent authority to ensure the ongoing safety of product.

c) The busbar trunking system should pass seismic tests with actual physical product and being certified complying with UBC seismic Zone 4 as per IEC condition by an international recognized earthquake research body, e.g. Asian Pacific Network of Centers for Earthquake Engineering Research (ANCER). **Each Vendor to submit Seismic test certificate & seismic calculations before order is finalized.**

- d) Discrimination and cascading of Busduct with Switchgear should be done, Vendor to submit detailed discrimination reports and discrimination is mandatory upto MCCB & MCB level.
- e) Switchgear & Busduct should be of same manufacturer.
- f) Busduct should have Salt-spray test of 700+ Hours.
- g) Reducer should be integral part of Busduct, Reducer should be factory made and should not have local box with two flange terminations design.
- h) Tap-off box should be type tested as per IEC 61439-6 with all 25 verifications. Tap-off should be factory fitted, and type test of tap-off box should be along with switch gear and should be part of test report.
- g) Vendor should have manufacturing plant and service & after sales support network in India.

**Construction**

**1. Housing**

- a) The busbar trunking housing shall be constructed of electro galvanized steel and aluminum to reduce hysteresis and eddy current losses and shall be provided with a suitable protective finish of ANSI 49 grey epoxy paint.
- b) The busbar trunking housing shall be totally enclosed non-ventilated for protection



	<p>against mechanical damage and dust accumulation. And it shall pass at least 700 hours salt spray test to ensure the anticorrosion ability.</p> <p>c) The totally enclosed housing shall be manufactured by the busbar trunking manufacturer. Modifications of busbar trunking to make it totally enclosed by other than the busbar trunking manufacturer voids the manufacturer's warranty. Busbar trunking so modified is unacceptable without the written consent of the manufacturer.</p> <p>d) For outdoor part busduct should be <b>IP-54 + Canopy</b></p> <p><b>2. Busbars</b></p> <p>a) Busbars shall be of hard drawn silver-plated high conductivity copper of 99.9% purity or aluminum with copper cladding utilized Molecular Fusion technology.</p> <p>b) There shall be no bolts passing through the busbars of the busway.</p> <p>c) Each busbar shall be insulated with Class B (130 °C DuPont Mylar). Epoxy insulation is not allowed.</p> <p>d) The temperature rise at any point of the busbar trunking enclosure shall not exceed 55 degree Centigrade rise above ambient temperature of 40 Degree when operation at rated current.</p> <p><b>3. Joint</b></p> <p>a) The busbar trunking joint shall be of the one-bolt type which utilizes a high strength steel bolt(s) and Belleville washers to maintain proper pressure over a large contact surface area. b) The bolt shall be torque indicating and at earth potential.</p> <p>c) The bolt shall be two-headed design to indicate when proper torque has been applied and require only a standard long handle wrench to be properly activated.</p> <p>d) Access shall be required to only one side of the busbar trunking for tightening joint bolts.</p> <p>e) It shall be possible to remove any joint connection assembly to allow electrical isolation or physical removal of a busbar trunking length without disturbing adjacent busbar trunking lengths.</p> <p><b>D. Support of busbar Trunking</b></p> <p>1. Hanger spacing shall be noted on layout drawings and shall not exceed manufacturer's recommendations.</p> <p>2. Indoor feeder and plug-in busbar trunking shall be approved for hanger spacing of up to 3 meters for horizontally mounted run and 4.88 meters for vertically mounted runs. Outdoor feeder busbar trunking shall be approved for spacing of up to 1.5 meters for horizontally or vertically mounted run</p>								
<b>4.0</b>	<b>SITE CONDITONS</b>								
	<table border="1"> <tr> <td><b>Location</b> RAJPIPLA MEDICAL CAMPUS</td><td><b>Site altitude</b> 50 M above mean sea level</td></tr> <tr> <td><b>Ambient temperature</b></td><td><b>Relative humidity</b></td></tr> <tr> <td>Maximum 47 °C</td><td>Maximum 98 %</td></tr> <tr> <td>Minimum 05 °C</td><td>Minimum 40 %</td></tr> </table>	<b>Location</b> RAJPIPLA MEDICAL CAMPUS	<b>Site altitude</b> 50 M above mean sea level	<b>Ambient temperature</b>	<b>Relative humidity</b>	Maximum 47 °C	Maximum 98 %	Minimum 05 °C	Minimum 40 %
<b>Location</b> RAJPIPLA MEDICAL CAMPUS	<b>Site altitude</b> 50 M above mean sea level								
<b>Ambient temperature</b>	<b>Relative humidity</b>								
Maximum 47 °C	Maximum 98 %								
Minimum 05 °C	Minimum 40 %								

# TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

	Design 45 <sup>0</sup> C		Design 98 % at 45 <sup>0</sup> C	
	Seismic factor Zone III as per IS:1893		Rainfall 1000 mm/year	
	Environmental Tropical/humid/corrosive conditions		Location of Equipment Indoor/Outdoor	
	Wind speed 80 kmph maximum			
	Electrical system data:			
	Power supply for Equipment			
	Voltage 415 V ± 5 %		Frequency 50 Hz ± 3 %	
	Permissible voltage & variation	combined frequency ± 6 %	System design faults level (Symmetrica l)	AS PER SPECIFIED IN SLD
	System earthing LV side neutral solidly earthed		Wiring 3 phase, 4 wire on 415V system	
	5.0	TECHNICAL REQUIREMENTS		
5.10	DRAWINGS & INFORMATION ALONG WITH OFFER  The bidder shall submit completely filled data sheet as per the given format along with Bus Bar calculations.  Submit list of spare parts required for the safe operation of equipment of 2 years.			
6.0	HANDING OVER DOCUMENTS  Rating and Diagram Plate  Kanopy drawings  Insulation test  Data sheet indicating results of tests  Test reports  O & M manuals			

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

<b>7.0</b>	<p><b><u>INSPECTION &amp; TESTING</u></b></p> <p>Following tests should be preformed as acceptance test at manufacturing place,</p> <p>Short circuit test.</p> <p>High voltage test.</p> <p>Measurement of insulation resistance</p> <p>Submission of test reports and certificates for all the bought out components from the sub-suppliers for the tests carried out at the respective manufacturer's works.</p>
<b>8.0</b>	<p><b><u>METHOD OF MEASUREMENT</u></b></p> <p>Supply of the Busbar Canopies including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.</p>
<b>9.0</b>	<p><b><u>TRANSPORT, DELIVERY &amp; STORAGE</u></b></p> <p>The prices shall be F.O.R. site basis including packing &amp; forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of transformer or site store. The transformer should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.</p> <p>The transportation for any auxiliary item or detachable part of equipment should be simultaneous and carry necessary instructions for assembling and storage requirements.</p>
<b>10.0</b>	<p><b><u>GUARANTEE &amp; WARRANTY</u></b></p> <p>The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply. The Purchaser also reserves the right to use the rejected equipment or part thereof until the new equipment meeting the guaranteed performance is supplied by the Bidder</p>
<b>11.0</b>	<p><b><u>SPARES</u></b></p> <p>The bidder shall quote for minimum spares required for two years safe operation of transformer along with the offer separately.</p>
<b>12.0</b>	<p><b><u>ATTACHMENT</u></b></p>

# TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

## DATA SHEET

Sr No	DESCRIPTION	SANDWICH BUS DUCT SYSTEM
1	Rating	AS PER SPECIFIED IN BOQ AND SLD
2	Conductor material	Aluminium
3	Type	Sandwich Type
4	System Configuration	3P,4Wire- 100% Neutral, 50% Integral Ground
5	Conductor Size	To Be Specified
6	Coating Material of Conductor	Silver Coated At The Joining Part
7	Overall Dimension	To Be Specified
8	Type	Indoor
9	Operational Voltage	415V
10	Withstand Voltage	To Be Specified
11	Short time current capacity	AS PER STANDARDS AND AMP RATINGS.
12	Temperature rise	Permissible 55 deg C above ambient of 40 deg C
13	Voltage drop	To Be Specified
14	Impedence Value	To Be Specified
15	Enclosure Material of Construction	GI sheet, inside outside galvanised and epoxy coated.
16	Paint Shade of Housing	ANSI 49 grey epoxy paint.
17	Thickness of Paint	40-60 Micron
18	Ingress Protection	IP 54
19	Overall Weight / mt	To Be Specified
20	Standard length of section	To Be Specified
21	Shortest length	500 mm
22	Insulation Material	Fire Retardant Epoxy insulation concentrically coated over the conductor by special purpose extrusion machine
25	Fire stop(or) Barrier	To Be Specified
26	Earthing Details	50% integral through Hosing
27	No of plug in openings in 3mts	To Be Specified
28	Space between openings	500 mm
29	Inspection of Plug in opening & Busbar prior to installation	Visual / Megger / HV Test
30	Fastening method of junction joints	Single Bolt Overlapped Jointing.
31	Joints adjustability for alignment	Single insulated bolt with torque indicating nut. M14 size, length 140 mm.
32	Torque required for tightening the Nuts and Bolts	13 - 15 Kg-m
33	Material of bolt and nut	HT Chromium plated and insulated bolt + Maintenance free nut + Belleville

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

34	Expansion Joints	Not Required
35	Supporting system - material	Vertical Spring Hanger and 'J' hook for horizontal support.
36	Spacing between support	Horizontal - Horizontal hanger every 1.5 mtr, Vertical spring hanger every floor(for floor
37	No. of Joints/Bends	To Be Specified
38	Connection	Flexible Cu Bus

### **20.0 Energy and Power Management Software Specification (EMS)**

#### **Software - General:**

19. Furnish a dedicated, edge control, software platform (The Software Platform) that is purpose-built to be the operational interface for an Energy and Power Management System (EPMS) whose primary purpose is to support the provision and management of safe, reliable and efficient power within buildings and facilities. The Software Platform shall have specialized data acquisition, visualization, analysis and reporting tools specifically designed for Power Management applications such as:

- a. Electrical Distribution System Monitoring and Alarming.
- b. Electrical System Capacity Management.
- c. Power Quality Monitoring and Compliance.
- d. Multi Source Management.
- e. Continuous Electrical Thermal Monitoring.
- f. Breaker Setting Monitoring.
- g. Backup Power Testing.
- h. Power Events Analysis.
- i. Energy Usage Analysis and Energy Benchmarking.
- j. Utility Bill Verification and Cost Allocation.
- k. Energy Performance Analysis and Verification.

20. The Software Platform shall natively support (no additional installation or configuration of

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

the software required) at least 100 devices specifically designed for power distribution and power quality monitoring including: programmable power analyzers, power meters, branch and multi-circuit meters, smart panels with communicating circuit breakers, protection relays, uninterruptable power supplies, active harmonic filters, capacitor bank controllers, electrical distribution thermal sensors.
a. All registers shall be pre-mapped to standard measurement names – no additional register mapping required.
b. All native device types will come with a comprehensive set of a factory device graphical screens – no additional graphics creation or installation required.
c. All native device types have been factory-tested and proven to perform.
21. The Software Platform's web applications shall be simultaneously accessible from their unique web addresses so that they may be embedded in other web-based software environments.
22. The functionality of the Software Platform shall be extensible whereby additional capabilities may be added via software license activation codes without the need to install additional software modules or add-ons.
23. The Software Platform shall be certified as part of an Energy Data Management System according to the sections of the following ISO standards:
a. ISO 50001
i. Energy review
ii. Energy baseline
iii. Energy performance indicators
iv. Monitoring, measurement, and analysis
v. Input to management review
b. ISO 50002
i. Data collection
ii. Measurement plan
iii. Analysis
iv. Energy audit reporting
c. ISO 50006
i. Obtain relevant energy performance information from the energy review
ii. Identify energy performance indicators
24. The Software Platform shall be certified to comply with cybersecurity standard IEC62443 at the component level: IEC62443-4-1 and IEC62443-4-2 (SL1).
25. The Software Platform shall be designed to streamline the process of checking and maintaining EN50160 and IEEE 519 Power Quality compliance.

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

26. The Software Platform shall natively support the vendor's continuous electrical thermal monitoring system with the ability to detect abnormal bus bar or cable temperatures due to loose or faulty connections and to prevent equipment damage and fire.
27. The Software Platform shall be designed to integrate and embed within the vendor's Building Management System (BMS) software platform to provide Energy and Power Management applications within the context of the BMS environment.
<b>Software - Real Time Monitoring:</b>
9. The Software Platform shall support Auto Network Diagram Creation whereby a comprehensive set of linked hierarchical graphical diagrams is automatically created for all directly connected devices in the power monitoring network.
10. The Software Platform shall support advanced power quality meters with onboard High Speed Power Analysis with Disturbance Direction Detection (DDD) capabilities and come equipped with a built-in set of real-time graphical indicators for use in electrical one-line diagrams that indicate:
a. The type of Power Quality Disturbance (sag, swell, transient).
b. The direction of Power Quality Disturbance relative to the compliant DDD device (upstream, downstream).
11. The Software Platform shall provide real-time indication of the aggregated demand being measured by one or more devices in a predefined zone. The application shall allow:
a. The demand for the zone to be expressed using either Kilowatts or normalized Kilowatts/Area.
b. Visual indication of how the present demand for a zone compares with four (4) configurable limits / targets using a color scale.
c. Configurable limits shall be further configurable to allow for the use of different values during an On-Peak period compared to an Off-Peak period.
12. The Software Platform shall allow web client users to quickly and easily create interactive dashboard visualization of any real-time measurements that:
a. Display tabular and trend line views to compare device readings from multiple devices in the power monitoring network including power meters, circuit breakers, protection relays, uninterruptable power supplies, automatic transfer switches and generators.
b. Permit users to create, modify, view and share views directly from the web client browser without the need for a separate software application.
c. Support both physical and virtual devices defined in the system.
d. Support exporting real time data into Excel formats directly from the web client browser environment.
<b>Software – Alarm and Event Analysis and Notification:</b>
15. The Software Platform shall be able to acquire specialized, high speed power disturbance

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

data directly from onboard advanced power quality meters for the purpose of Power Events Analysis, including:
a. Timestamped Power Events with Disturbance Direction Detection (DDD).
b. Timestamped high speed (1/2 cycle sample rate) pre/post event RMS data.
c. Pre/post event waveform captures (Voltage and Current all phases).
16. The Software Platform shall provide a web based power events analysis application that includes but is not limited to the following features:
a. Automatic, intelligent clustering of events into alarms and multiple alarms from multiple devices into “incidents” to simplify the analysis of multiple cascading events.
b. Automatic categorization of alarms and incidents into predefined categories such as Power Quality, Power Availability, Diagnostics and Other.
c. Predefined views for events, alarms and incidents with intuitive navigation and easy to use, configurable filters based on priority, status, source and categories.
d. Ability to create private or shared event, alarm and incident views with custom filters.
e. Popup window with detailed information about where, what and when an alarm or incident happened, plus other relevant information including Power Quality details and a thumbnail summary view of all waveforms associated with the alarm or incident.
f. For Power Quality alarms or incidents captured by Disturbance Direction Detection (DDD) compliant devices there shall be clear graphical indication of the direction of the disturbance (upstream or downstream relative to the DDD compliant device).
17. The Software Platform shall provide a graphical timeline view of alarms and events that constitute an “incident” in the electrical distribution network. The timeline view shall:
a. Display alarms/events stacked by order of time for sequence of events analysis.
b. Display the start and end of alarms/events with color-coded dots.
c. Indicate the direction of a Power Disturbance and if there are captured waveforms associated with the incident.
d. Have a configurable analysis window with a color-coded time slider that uses color to indicate areas in the timeline where there are greater numbers of alarms.
e. Be able to display pre- and post-event high speed RMS data coming from supported power quality meters.
18. The Software Platform shall include a web-based Smart Waveform Analyzer interface with the following capabilities:
a. Toggle on/off Voltage/Current channels.



## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

b. RMS calculation, zoom, pan, export to CSV.
c. Interactive phasor and harmonic (voltage and current) diagrams.
d. Allow multiple waveforms to be compared to each other.
19. The Software Platform shall include an alarm annunciator to display the total number of unacknowledged alarms with a breakdown of how many are high, medium and low priority and shall allow easy navigation to the alarm viewer with a single click.
20. The Software Platform shall provide the ability to send email notifications based on recent changes to the system which will be used to formulate notification types including:
a. Communication Loss Notification – sent when the Software Platform loses communication with selected devices.
b. Alarm Summary Notification – sent regularly to indicate changes in the average amount of high, medium, and low priority alarms.
c. Power Quality Event Notification – sent regularly to indicate changes in the average amount, duration, and magnitude of Sag, Swell and Transient power disturbances.
21. The Software Platform shall have a web-based Alarm Configuration interface to allow end users to create smart alarms with the following capabilities:
a. Realtime Analog and Digital Setpoints with options for time delays and custom alarm labels.
b. Smart Over/Under Setpoints designed specifically for energy (WAGES) and power alarms based on historical average, standard deviation or maximum with options for time ranges, aggregation periods, multipliers and ability to compare specific time periods (Same Hour of Day and/or Same Day of Week).
c. Communication Loss alarms with options for sensitivity and custom alarm labels.
d. Schedules interface for end users to configure when smart software alarms are active or not.
<b>Software – Data Analytics and Visualization:</b>
17. The Software Platform shall include an interactive, web-based Dashboard application that provides auto-updating dashboard views that may contain not only energy and power data but water, air, gas, electric, and steam (WAGES), historical data trends, power quality performance data, images, and content from any accessible URL address.
18. Users shall be able to create, modify, view, and share their dashboards (including graphics, labels, scaling, measurements, date ranges, etc.) using only a browser and without the need for a separate software application to design, create, modify or publish dashboards.
19. The Software Platform shall support kiosk slideshow displays by assigning individual dashboards to slideshows to run in unattended mode, scrolling through designated dashboards at a configurable time interval.
a. Any number of kiosk slideshow displays may be created and configured to run

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

independently on any computer using a browser.
20. The Dashboard application shall provide a library of standard graphical objects (gadgets) including Bar, Pie, Trend, Real Time and Web Portal.
21. The Dashboard application shall provide a library of specialized energy usage graphical objects (gadgets) including Period Over Period Comparison, Pareto Charts, Heat Map / Carpet Plot and Sankey Diagrams.
22. The Dashboard application shall provide a library of specialized Power Quality graphical objects (gadgets) including PQ Downtime Impact, PQ Rating, PQ Incident Breakdown and Location.
23. The Software Platform shall provide an interactive, web-enabled Reports application that allows users to generate, modify, save and manage reports based on pre-formatted report templates (up to 64 templates) that are designed to support the following:
a. Energy Cost Allocation and Bill Verification.
b. Energy Usage, Modeling and Performance Verification.
c. Power Quality Performance and Compliance (EN50160 and IEEE 519).
d. Electrical Equipment Operation and Performance (Breakers, UPSs, Generators).
24. The reporting tool shall support automatic distribution (via email or shared folder) on a schedule basis or based on event or manual export using the following output formats: .csv, .xlsx, .pdf, .tiff, .html, .xml.
<b>Software – Technical Infrastructure:</b>
46. The Software Platform shall be able to be installed on a physical computer or virtual machine and shall support a variety of Windows operating systems including Server and non-Server class Windows operating systems.
47. The Software Platform shall support a variety of SQL Server Editions including Enterprise, Standard and Express Editions.
48. The Software Platform shall only require SQL Server Database Engine Services and Basic Management Tools and not require the installation of any other additional SQL components such as Analysis Services or Reporting Services.
49. The Software Platform shall support the following cybersecurity features:
a. Encrypt the transmission of data between the Software Platform Server and its Web Clients using Transport Layer Security (TLS) version 1.2.
b. Establish secure authentication between the Software Platform Server and its Web Clients using Certification Authority (CA) certificates.
c. Encryption and hashing of system credentials using AES256 and SHA-512 respectively.
d. Capable of installing into a Federal Information Processing Standard (FIPS) compliant

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

environment.
e. Application Whitelisting.
50. The Software platform shall support the integration of Windows Active Directory for users and groups from across multiple domains to facilitate the following:
a. Login to the Software Platform using Windows credentials.
b. Enforce password policies via Windows (complexity and expiration).
c. Role-Based Access Control (RBAC).
51. The Software Platform shall intelligently and automatically acquire data from devices, including onboard events, trends and waveforms from natively-supported device types:
a. Without any need for software configuration or data upload scheduling.
b. Onboard, high resolution timestamps (1ms) shall be retrieved without degradation or modification even for devices that support clock synchronization via GPS, IRIG-B, NTP or PTP (Precision Time Protocol).
52. The Software Platform shall support logical device definitions based on inputs/outputs or channels on devices that represent a downstream device with the following features:
a. Software user interface for device and measurement mapping.
b. Bulk-import capability to create large numbers of logical devices without manual single-device configuration.
53. The Software Platform shall support real-time and historical data aggregation within defined hierarchy views (e.g. Tenants/Racks/Circuits, PDUs/RPPs/Panels, Buildings/Floors/Rooms, or any user defined view) with the following capabilities:
a. Web-based, end user interface.
b. Automatic and intelligent data aggregation across all nodes in the hierarchy for data visualization in Dashboards, Trends and Reports.
c. Creation of virtual devices to enable applications such as net metering, common area allocation and apportionment.
d. Update node names and associated time ranges in the hierarchy to properly reflect and accurately report on facility changes (e.g. tenant move in – move out).
e. Bulk-import capability to create and edit large hierarchies without manual per-device setup.
54. The Software Platform shall support OPC DA Server 2.01 with the following capabilities:
a. Provide default OPC Server tag mappings for all natively supported device types without the need to select, configure, or program the mapping of device registers to OPC tags.
b. Provide a flexible means to add or change OPC mappings and shall support the ability to add custom measurements.

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

55. The Software Platform shall support OPC DA Client 2.01 and come with a built in OPC Test Client.
56. The Software Platform shall support device-level Modbus integration with the following capabilities:
a. Modbus master to read/write registers in Modbus devices for monitoring and control applications.
b. Support for at least 70 Modbus data formats including 16bit Signed/Unsigned Integers (S16-21, S16-12, U16-21, U16-12, S16-1-15),
57. The Software Platform shall have a single, end user software application specifically designed for integrating Modbus and OPC device types and shall have the following capabilities:
a. Simple creation and management of Modbus and OPC device definitions (device drivers) and association of device graphic template screens.
b. Pre-defined, default measurement system (Common Data Model) for consistent mapping of Modbus registers and OPC tags to standard measurements.
58. The Software Platform shall support Web Services interoperability with the following capabilities:
a. Web Services Server for sharing real-time, historical (i.e. timestamped trend data), and alarm data (i.e. timestamped event strings) from the Software Platform to other Web Services Client applications.
b. User interface for Web Services configuration and mapping.
c. Provide the ability to acknowledge alarms by authenticated and authorized clients.
59. The Software Platform shall have an Extract, Transform, and Load (ETL) engine for exchanging data between files, databases and systems with the following capabilities:
a. User Interface for specifying connection information, data formats, measurement mappings and schedules.
b. Support for importing data from .csv and .xml data files, Wonderware Historian databases and other 3rd party databases via OleDb connections.
60. The Software Platform shall support system-wide programs using a graphical, object-oriented application engine capable of logic and arithmetic functions, database queries, XML data import, complex logic-based alarming and data logging, email and text notifications.
61. The Software Platform shall remain online (including communications, logging, and alarming) and not require an operator to take the system offline during all system administration functions such as adding, modifying, or removing devices in the system; creating, modifying, or removing graphical diagrams, dashboards, tables, and reports; creating, modifying, or removing application logic programs in the application logic engine.
62. The Software Platform shall support offline software configuration management for efficient system deployments and upgrades with a dedicated user interface for creating, copying and

## TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

deploying software configuration projects.
63. The Software Platform shall support internationalization and regional settings.
64. The Software Platform shall support the ability to change its default language at any time directly from the web client without the need for any additional installation or advanced software configuration.
65. All bidders should consider complete scope of Energy Management system with all the accessories like Software, PC, SQL License, with UPS with one Web view license, Lan cable, Communication Cable, Ethernet Gateway with supply and commissioning of complete project.
66. <b>PC Server specification</b> should be as follows:
· Server PC (Intel Xeon E3-1220v5/ 16GB RAM / 1TB SAS
· Monitor: 21.5" TFT LED Back Lit Monitor
· Windows Server 2016 Std
· Ms-Office 2016
· Quick Heal Antivirus for Server PCs for 3 Years
67. SQL Server : Microsoft SQL Database standard version 2014/16/17.
68. Communication Architecture: All Contactors should provide complete cost of EMS with all devices as per below Architecture.

