



**SECTION XIV**  
**SPECIFICATION FOR ELECTRICAL**  
**INSTALLATION WORK**



## **SECTION XIV - SPECIFICATION FOR ELECTRICAL INSTALLATION WORK**

### **BILL OF MATERIAL**

Below list of item is likely to be used in the project . However, final capacity/size/rating etc shall be decided during detailed engineering and they should be got approved from EIC.

This list should be considered as technical specifications .For any query or discrepancy follow the detail tender specifications or IS Rules decision of EIC shall be final and binding.

The list below is indicative, not exhaustive. Necessary items required to be added for satisfactory completion of the project should be considered as part of the scope of work.

1. Point wiring for Light / Bell with 2-1.5 sq.mm & earthwire of 1.5 sq.mm (Green) both are of ISI marked 1.1 KV grade FRLS PVC insulated multistrand copper wires, in following type of pipe to be erected concealed in/ on surface on wall/ceiling complete with 6A Modular type switch / bell push & accessories and earth continuity of following type, erected on PVC / Metallic box, single mounting base frame covered with textured/metallic front plate modules erected on / in wall / ceiling as per pipe erected, with necessary Lamp holder/ceiling rose / H.D.Connector as directed. (a) with medium class Rigid PVC pipe and accessories Cat III.
2. Point wiring for Secondary Light with 2-1.5 sq.mm & earthwire of 1.5 sq.mm (Green) both are of ISI marked 1.1 KV grade FRLS PVC insulated multistrand copper wires, in following type of pipe to be erected concealed in/ on surface on wall/ceiling complete with 6A Tissino ISI marked flush type switch / bell push & accessories erected on Metal/PVC Box covered with 3 mm thick PC ( Polycarbonate)acrylic sheet with necessary Lamp holder/ceiling rose / H.D.Connector as directed. Note:- Maximum up to 6 mtrs length, excess will be considered as Mains for Secondary Point. (a) with medium class Rigid PVC pipe and accessories
3. Point wiring for FAN with 2-1.5 sq.mm & earth wire of 1.5 sq.mm (Green) both are of .ISI marked 1.1 KV Grade FRLS PVC insulated multistrand copper wires, in following type of pipe to be erected Open/ concealed in / flushed on wall/ceiling complete with 6A Modular type switch and hum free EME four or more step type electronic fan regulator with separately mounted and accessories with earth continuity of following type erected on PVC / Metallic box, single mounting base frame covered with textured/metallic front plate modules erected on / in wall / ceiling as per pipe erected. with necessary ceiling rose / H.D.Connector as directed. (a) with medium class Rigid PVC pipe and accessories. Cat.III
4. Point wiring for Individual Plug with & earth wire of 1.5 sq.mm (Green) both are of ISI marked 1.1 KV grade FRLS PVC insulated multistrand copper wires, in following type of to be erected Open/ concealed in / on surface of wall / ceiling complete with Modular type switch & 5 pin Plug erected on PVC / Metallic box covered with appropriate front plate modules erected on / in wall / ceiling as per pi pe erected with following type of accessories. (a) with medium class Rigid PVC pipe and accessories. Cat. III

[I] For 6A Plug with 2-1.5 sq.mm Cu. Wire

[II] For 16A Plug with 2-2.5 sq.mm Cu. Wire (a) with medium class Rigid PVC pipe and accessories. Cat. III



[III] For 16A Plug with 2-4 sq.mm Cu. Wire (a) with medium class Rigid PVC pipe and accessories. Cat. III

5. Point wiring for Looped Plug with 6A Modular type switch & 5 pin socket erected on PVC / Metallic box, single mounting base frame covered with textured / metallic front plate modules erected on / in wall / ceiling with following type accessories. Cat. III

6. Point wiring for Two Way Controlled Light Point with 2-1.5 sq.mm & earth wire of 1.5 sq.mm (green) both are of .ISI marked 1.1 KV grade FRLS PVC insulated multistrand copper wires, in following type of pipe to be erected Open/ concealed in/ flushed on wall/ ceiling, complete with 6A Modular type switches and following type of accessories erected on PVC/ Metallic box, single mounting base frame covered with textured/ metallic front plate modules erected on/ in wall/ ceiling as per pipe erected. With necessary batten/angle holder or ceiling rose or H.D.Connector as directed.(a) with medium class Rigid PVC pipe and accessories Cat. III

7. Mains with 1.1 K.V .grade FRLS PVC insulated ISI marked Stranded Copper conductor wire in rigid pvc pipe to be erected concealed in / flushed on wall / ceiling with 1.5 Sq.mm. copper conductor FRLS PVC insulated stranded wire of green color for earth continuity of following size . (a) with Medium class Rigid PVC pipe and accessories.

- a. 2 wire 1.5 sqmm.      b. 2 wire 2.5 sqmm.      c. 3 wire 2.5 sq. mm

8. Mains with 1.1 KV grade FRLS PVC insulated ISI marked stranded Copper conductor wire in following type of pipe to be erected in / on wall / ceiling with 2.5 sq. mm copper conductor FRLS PVC insulated stranded wire of green colour for earth continuity of following size '(a) with medium class Rigid PVC pipe and accessories

- a. 2 wire 4 sq. mm  
b. 3 wire 4 sq. mm  
c. 4 wire 6 sq. mm

9. Providing & Erecting approved make following size of TV Co-axial flexible cable comprising inner conductor of solid bare copper insulated with Foam PE & Secondary conductor made of poly - Aluminium film bonded Al. Braids @ suitable coverage overall sheathed with black PVC insulation. b).RG-6

10. Supplying & erecting Delton or approved make Telephone Cable electrolytic copper conductor PE insulation twisted in two pairs, & wrapped with FRLS PVC tape & sheathed with FRLS PVC or HFFR outer Jacket suitable for telephone wiring & confirming to C-DOT erected in existing pipe. of following size of conductors &nos.of pairs. With necessary connections. [A] Conductor Size 0.5 mm (a) Unarmoured

- a. Two Pairs      b. Ten Pairs      c. Twenty Pairs



11. Supplying & erecting approved make LAN cable of following size in existing pipe as per direction [D] CAT - 6 e
12. Providing and erecting ISI mark Medium class RIGID PVC PIPES of following size complete to be erected on/in wall or ceiling erected with necessary PVC fittings & Junction boxes fixed with adhesive solution & Clamps with following dia of pipes, in approved manner as directed
- a. 25 mm      b. 32 mm
13. Providing & erecting PVC Corrugated Flexible Conduit with required nos. of coupling, PVC bushes, Check-nuts etc. complete of following sizes.
- a. 25 mm      b. 32 mm
14. (A) Supplying and laying UPVC PANEL TRUNKING (CABLE DUCT) system comprising unplasticised polyvinyl, chloride rigid material with ignition free & flame proof confirming BS .All necessary accessories and measuring of following sizes.
- (1) 60 mm x 45 mm trunking.  
(2) 100 mm x 50 mm trunking
15. Supplying & laying under floor pregalvanised corrosion proof rectangular sheet steel cable trunking of 1.6 mm thick having with stand point load up to 1.33 Ton & free from seepage of concrete of screed water having following size of dimensions and No of compartments (W x D x T)
- [3] 100mm x 25mm x 1.6 mm with one compartment  
[6] 300mm x 25mm x 1.6 mm with Three Compartments
16. Floor mounted metal S.S. outlet (under floor service) made of high quality ABS & polyamide materials with trap frame & screw less ratchet trap lead with screw less knob reinforced with 2.5mm thick pregalvanised steel plate of following size.
- [2] 300mm x 300mm x 60/75 mm (Metal lead) Three Compartments
17. G.I. Junction cross over box for metal / Al. trunking with duct entry 25mm x 38mm size having epoxy powder coated trap lead with corrosion & rust free having load bearing capacity of 5 TONS with adjustable levelling screw of following size.
- [3] 300mm x 300mm x 60/75 mm depth
18. Providing and fixing approved make Ladder type cable tray. Made from M.S sheet. The cable tray should be bended as per IS 2062/1079 shall be fabricated of double bended channel section longitudinal members with single bended Channel section. Rungs of members welded to the base of the longitudinal members at 250 mm c/c spacing . as per IS and shall be coated with hot dip galvanizing as per IS 2629/4759. with coupler plate / Fish plate and GI hardware like nut - bolt and washers etc. erected on existing support as per Specification and as per instruction of engineer in charge..
- a. 200 X 50 X 1.5 mm Thick  
b. 300 X 50 X 1.5 mm Thick



19. Providing and fixing approved make Perforated C type cable tray. Made from CR sheet steel. The cable tray should be single or double bended as per required and as per IS 2062/1079 and shall be coated with hot dip galvanizing as per IS 2629/4759. with coupler plate / Fish plate and GI hardware like nut - bolt and washers and other accessories etc. erected on existing support as per Specification and as per instruction of engineer in charge..

(5) 300 X 50 X 1.5 mm Thick

20. Accessories mounted with PVC / metallic box, covered with appropriate front plate modules erected with necessary connection.

- a. Two pin RJ-11 Telephone socket with top Cat. III
- b. TV Co-axial Socket outlet - Cat III
- c. Modem Jack for Computer Open RJ-45 Cat. III
- d. 6/16Amp. Universal socket Cat. III
- e. 16/20/25 Amp. Modular Starter for Motor / A.C. Unit Complete Cat. III

21. Providing & erecting Switch board for Computer or electric apparatus consisting of following items in single board erected on PVC / Metal board with 3 mm thick PC (Polycarbonate) / Acrylic sheet erected as directed [B] For Modular Type Accessories Cat. III

- 1 no. 6A/16A universal plug-switch combined.
- 4 nos. 6A Switch
- 4 nos. 6A 5 pin Plug

22. SETC of Main Panel as per Rate analysis and site requirement and Instructed by Incharge Engineer.

23. SITC of 250 kVAR APFCR Panel Complete with all switchgear etc.as per SLD and Detailed Specification a.63 Amps four pole Cat III.

24. Approved make Four Pole LT Heavy Duty Switch Disconnecter Fuse Unit Cubical type for panel mounting complete with operating mechanism suitable to operate on 415V A.C. With HRC fuses of suitable load confirming to IS. 13947 (Part I& III). of following capacities with Encloser

- (b) 63 Amp Cat III
- (g) 400 Amp Cat III
- (i) 800 Amp - Cat.III

25. Providing and erecting busbar chamber confirming to IS-375 fabricated from 16 G.M.S. sheet, dust & vermin proof having hinged door with rubber gasket and necessary busbar supports with COPPER busbar having current density not more than 1.6 Amp. / sq.mm (Rated current / cross section area) duly wrapped with colour insulation tape for phase sequence, three phase & neutral each suitable for following current capacity with necessary painting mounted on wall or pedestal frame of required size with necessary connections.

- (A) Suitable for 63/100 Amp. capacity
- (B) Suitable for 200 Amp. capacity
- (C) Suitable for 400 Amp. capacity
- (D) Suitable for 800 Amp. capacity



26. Miniature circuit breaker single pole 6A to 32A suitable to operate on 240 V A.C. system and having breaking capacity 10 KA to be erected in existing box. confirming to IS 8828/1996 with ISI Mark Cat. III
27. Providing & erecting 240 V MCB double pole switch for motor & inductive load (C Curve) having 10 KA breaking capacity & confirms to IS : 8828 in existing box having following capacity
- (A) 6 to 32 Amp. Cat.III
28. Providing & erecting 415 V MCB Four Pole for Motor & Inductive Load (C Curve) having 10KA breaking capacity & confirms to IS :8828 in existing box having following capacity
- a. 6 to 32 Amp. Cat.III b. 63 Amp. Cat.III
29. Sheets steel powder coated enclosure suitable for incorporating One/Two Pole MCB.
30. Sheets steel powder coated enclosure suitable for incorporating Three/Four Pole MCB.
31. Providing and erecting Sheet Steel powder coated MCB distribution board - flush / surface mounted fitted with busbar, neutral link, earth bar and DIN rail, confirming to IS 13032 and BS 5486-1986 without MCB to house appropriate nos. of MCBs.(The DBs should be used of same company of MCB to be used)
- (A) Single phase 4 way single door  
(B) Single phase 4 way SS Double door  
(C) Single phase 6way single door  
(E) Single phase 8 way single door  
(F) Single phase 8 way SS Double door  
(H) Single phase 12 way SS Double door  
(J) Three phase 4 way SS Double door for single phase outgoing horizontal Box  
(N) Three phase 8 way SS Double door for horizontal single phase outgoing
32. Approved make ELCBs / RCCBs conforming to IS: 12640 and having sensitivity of 30 mA and Short Circuit withstand capacity of 6 KA and suitable for operation on single phase 240 V. having characteristic of quick action & tripping with all advance feature & do not incorporate any electronic component. for following Max. rating erected as directed.
- (i) 25 Amps.DP- Cat III  
(ii) 40 Amps. DP Cat.III
33. Approved make ELCBs / RCCBs conforming to IS: 12640 and having sensitivity of 30 mA and Short Circuit withstand capacity of 6 KA and suitable for operation on 3 phase and neutral 415V. having characteristic of quick action & tripping with all advance feature & do not incorporate any electronic component for following Max. rating erected as directed.
- (ii) 40 Amps. FP Cat.III  
(iii) 63 Amps. FP - Cat. III



34. Cable Junction Boxes IP 66 “halogen free and weather proof” With Terminal Make: Hensel, MK, Legrand  
93X93X62 MM KF 0202 B  
130X130X77 KF 0606 B  
150X210X92 KF 1616 B  
205X255X112 KF 2525 B
35. Supplying and erecting bakelite sheet 12mm thick HYLAM make on existing angle iron frame.
36. Supplying rubber matting of 12 mm thickness as per IS 5424 and of required length and breadth with good insulation property for 22 KV
37. Providing printed instruction chart both in English and Gujarati and duly framed with front glasses, for treatment of person suffering from Electric shock
38. Providing & fixing G.P. L-Slotted Angle (3" Gap, 16 Gauge ) and M.S L-Type Patti Bracket With PVC Coated (8mm) Nut-Bolts (with 2 washer) and 3" Khila on wall at Levels of approved design including the cost of cutting, drilling holes & make good the wall etc complete-For Meter Fitting Arrangement of Single/Three Phase Meterbox (with MCB) as per site requirement.
39. Mains with ISI marked, 1.5KV grade electrolyte multi stranded, annealed copper conductor with heat resistant PVC insulated conforms to IS 694, IEC - 227 erected in existing pipe of following size (Specifically for control panel, relays, power switchgears, motor starters & control wiring) with required size of copper lugs, nuts and bolts if required.
- (k) One wire 70.00 sq. mm
40. Supplying & erecting Flexible PVC insulated multistrand multicore 1.1 KV grade ISI marked Copper Wires of following Size to be erected as directed.
- a. 1.50 Sq.mm 2 core round PVC sheathed  
b. 2.50 Sq.mm 3 core round PVC sheathed  
c. 4.0 Sq.mm 3 core round PVC sheathed
41. (A) Supplying & erecting XLPE(IS:7098)(I)-88 ISI unarmoured copper cable 1.1 KV grade to be erected as directed of following size.
- a. 3 core 4 Sq. mm      b. 4 core 4 Sq. mm      c. 4 core 6 Sq. mm      d. 4 core 10 Sq. mm
42. (B) Providing and erecting XLPE(IS:7098)(I)-88 ISI armoured cable multistrand Copper conductor for 1.1 KV. to be laid on wall with necessary clamps or in existing trench / pipe at road crossing or floor of following size of cable.
- a. 4 core 2.5 Sq. mm      b. 4 core 4 Sq. mm      c. 4 core 6 Sq. mm      d. 4 core 10 Sq. mm
43. Providing and erecting XLPE(IS:7098)(I)-88 ISI armoured cable multistrand Aluminium conductor for 1.1 KV. to be laid on wall with necessary clamps or in existing trench / pipe at road crossing or floor of following size of cables.
- (A) 3 1/2 core 25 Sq.mm ( 16 Sq. mm 1/2 core)





- (B) 3 1/2 core 50 Sq.mm ( 25 Sq. mm 1/2 core)
- (C) 3 1/2 core 70 Sq. mm ( 35 Sq. mm 1/2 core)
- (D) 3 1/2 core 185 Sq.mm ( 95 Sq. mm 1/2 core)
- (H) 3 1/2 core 240 Sq. mm( 120 Sq. mm 1/2 core)
- (J) 3 1/2 core 400 Sq.mm ( 185 Sq. mm 1/2 core)

44. Making trench in Hard Murrum / Tar Road of suitable width of 90 cms or required depth for laying any size of cable or locating the fault all over the run and back filling the same and making the surface as normal ground.

45. Providing & laying. R.C.C. hume pipe for cable to be laid 90 cms. below ground across the road crossing or on floor with necessary material in an approved manner and making the ground as per original.

- a.150 mm dia
- b.250 mm dia

46. Providing & laying. Double walled corrugated pipes (DWC) of polyethylene(conforming to IS 14930 II )with necessary connecting accessories of same material at required depth for laying of cable. below ground / road surface for enclosing cable and back filling the same to make ground as per original.

- a. O.D. 50 /I.D. 38 mm dia
- b. O.D. 90 /76 I.D. mm dia

47. Cable Termination

Providing and, fixing heavy duty flange type brass cable gland with rubber ring for PVC insulated armoured cable complete with out going tails, insulating tape etc for following size of cables.

- (c) 2 to 4 core 6 Sq. mm
- (d) 2 ot 4 core 10 Sq. mm
- (e) 2 to 4 core 16 Sq. mm

48. Providing and, fixing heavy duty flange type brass cable gland with rubber ring for PVC insulated armoured cable complete with out going tails, insulating tape etc for following size of cables.

- (A) 3 & 1/2 / 4 core 25 Sq.mm
- (B) 3 & 1/2 core 35/50 Sq. mm
- (C) 3 & 1/2 core 70 Sq. mm
- (D) 3 1/2 core 185 Sq.mm
- (H) 3 1/2 core 240 Sq. mm
- (J) 3 1/2 core 400 Sq.mm

49. Solder less crimping type Aluminium lugs conforming to IS suitable for cable of following size evenly crimped with high pressure tool & connected to switchgear terminals with brass/cadmium plated nut bolts in an approved manner.

- (A) 1.5/ 2.5/4/6 Sq.mm
- (C) 16 Sq.mm.
- (D) 25 Sq.mm.





- (E) 35/50 Sq.mm.
- (F) 70 Sq.mm.
- (J) 185 Sq.mm.
- (K) 225 Sq.mm.
- (M) 400 Sq.mm.

50. Solder less crimping type Copper lugs conforming to IS suitable for cable of following size evenly crimped with high pressure tool & connected to switchgear terminals with brass/cadmium plated nut bolts in an approved manner.

- (A) 1.5/2.5 to 6 Sq.mm

51. Providing and erecting ISI marked PVC insulated PVC Sheathed Flat flexible Submersible copper cable approved make of following Size.

- (b) 3 Core x 2.5 Sq. mm.
- (c) 3 Core x 4 Sq. mm

52. Manhole

Construction of man holes as per following specifications for providing passages to lay the cables. Providing 900 mm(B) x 900 mm(W) X 1000 mm(D) manhole complete with 6" thick brick wall, plastering on both sides and providing C.I. hinged cover complete in all respect.

53. Supplying and erecting LED indoor fittings with LEDs of wattage 0.2 Watt to 0.5 Watt assembled on single MCPCB, with housing used as a heat sink shall be made of thick sheet Steel conforming to IS: 513/CRCA polyester powder coated and high U.V. & corrosion resistance with diffuser and/or Polycarbonate optics with company mark/name

120 to 300 V, Power Factor more than 0.9, THD < 10 %,

CCT 4000 K to 6500K, Uniformity ratio >0.7,

Luminaire efficacy > 85 lumens/watt ,

LED driver efficiency > 85 %

CREE / OSRAM / PHILIPS Lumileds / NICHIA / SEOUL/Bridgelux(U.S.A.) make LED used for luminaire. (Each fitting required LM-79 & LM-80 Certificates) (A) Tube Light with integral/ non-integral driver (d) 20-22 Watts, Surge - 4KV, IP-20, 4 feet Cat III

54. Supply, Erection, Testing & Commissioning of 10 watt LED Bulk Head luminary, having min. 600 lumen out put, with housing made of high pressure die cast aluminum & Poly carbonate front diffuser, IP66 protected & having impact resistance of IK09.

Make: Philips, Havells, Bajaj, Crompton, Schreder

55. Providing and erecting LED recessed mounting fitting complete with holder with lead wire and connection and adapter (2' X 2')

Make: Philips RC140B

LED29S-6500 PSE WH Bajaj-BXTBLR36 WH, Crompton-LCTAR1-40-CDL, Havells-LHEWEBP6IN1W036.

Contractor Has to submit NABL approved

Laboratory LM 79 and LM 80 Test certificate of model to be offered for confirmation of above



specification.50. Providing and erecting HOT deep Galvanized iron strip (25X3 MM) or 8 SWG GI Wire. Final Decision is taken by EIC. Providing and Erecting Frame for above fitting if required.

56. Supplying and erecting LED indoor fittings with LEDs of wattage of 0.2 Watt to 0.5 Watt assembled on single MCPCB, with housing used as a heat sink shall be made of thick sheet Steel conforming to IS : 513 / CRCA polyester powder coated and high U.V & corrosion resistance with diffuser and/ or Polycarbonate optics with company mark / name engraved or embossed. 120 to 300V, Power Factor more than 0.9, THD < 10%, CCT 4000K to 6500K, Uniformity ratio > 0.7, Luminaire efficacy >85 lumens/watt. LED driver efficiency > 85%. CREE / OSRAM / PHILIPS LUMILEDS / NICHIA / SEOUL / BRIDGELUX (U.S.A) make LED used for luminaire. (Each fitting required LM-79 & LM-80 certificates) (C) Square /Circular, Surface / Recessed Mounted Downlight with provision for spring loaded mounting clips complete. Final Decision is Taken By EIC/Consultant

- (a) 5-7 watts, Surge - 2KV Cat III.
- (b) 10-15 watts, Surge-4KV Cat III.
- (C)20-24 watts, Surge-4KV Cat III.

57. Supplying and erecting LED indoor fittings with LEDs of wattage of 0.2 Watt to 0.5 Watt assembled on single MCPCB, with housing used as a heat sink shall be made of thick sheet Steel conforming to IS : 513 / CRCA polyester powder coated and high U.V & corrosion resistance with diffuser and/ or Polycarbonate optics with company mark / name engraved or embossed. 120 to 300V, Power Factor more than 0.9, THD < 10%, CCT 3000K to 6500K, Uniformity ratio > 0.7, Luminaire efficacy >85 lumens/watt. LED driver efficiency > 85%. CREE / OSRAM / PHILIPS LUMILEDS / NICHIA / SEOUL / BRIDGELUX (U.S.A) make LED used for luminaire. (Each fitting required LM-79 & LM-80 certificates) (G) Spot Light , 5W, 425 Lumens, Surge-2KV Final Decision is Taken By EIC/Consultant

- (a) 5/7 Watts Cat III Spotlight, Cat III
- (b) 11 Watts Spotlight, Cat III

58. Providing & erecting Indoor / Outdoor type High Brightness SMD-WP-5050 (IP 68) LED chip comes with flexible ribbon with self adhesive back provide even light spread with 120 degree viewing angle suitable for outdoor version, Water proof Master or Nano Profile. Rated wattage 2.88, with 1M LED Strip with driver and its housing box for Warm white / Blue / Magenta / White / RGB Final Decision is Taken By EIC/Consultant

59. Supplying and erecting 40W LED outdoor post top fittings with made of pressure die-cast aluminium IP 65 housing and clear glass with diffuser and/ or Polycarbonate optics with company mark / name engraved or embossed. Price is include with 4 Mtr GI Pole with powder coated and smooth finished of same colour of fittings or as per instructed by architect. 120 to 300V, Power Factor more than 0.9, THD < 10%, CCT 3000K to 6500K, Uniformity ratio > 0.7, Luminaire efficacy >85 lumens/watt. LED driver efficiency > 85%. CREE / OSRAM / PHILIPS LUMILEDS / NICHIA / SEOUL / BRIDGELUX (U.S.A) make LED used for luminaire. Equivalent make of Havells Spring 5, Philips, Crompton, Schreder. Final Decision is Taken By EIC/Consultant

60. Supplying and erecting 9W LED outdoor type Bollard fittings with new generation, energy saving, environmental friendly, long life aesthetically designed made of pressure die-cast aluminium IP 65 housing with diffused lighting. Luminairheight is 500mm. 120 to 300V, Power Factor more than



0.9, THD < 10%, CCT 3000K to 6500K, Uniformity ratio > 0.7, Luminaire efficacy > 85 lumens/watt. LED driver efficiency > 85%. CREE / OSRAM / PHILIPS LUMILEDS / NICHIA / SEOUL / BRIDGELUX (U.S.A) make LED used for luminaire. Equivalent make of Havells BAMBOO, Philips, Crompton, Schreder. Final Decision is Taken By EIC/Consultant

61. Supplying and erecting 80W LED outdoor type facade flood light fittings with new generation, energy saving, environmental friendly, long life aesthetically designed made of pressure die-cast aluminium IP 65 housing with diffused lighting. 120 to 300V, Power Factor more than 0.9, THD < 10%, CCT 3000K to 6500K, Uniformity ratio > 0.7, Luminaire efficacy >85 lumens/watt. LED driver efficiency > 85%. CREE / OSRAM / PHILIPS LUMILEDS / NICHIA / SEOUL / BRIDGELUX (U.S.A) make LED used for luminaire. Equivalent make of Havells JETA Linear, Philips, Crompton, Schreder. Final Decision is Taken By EIC/Consultant

62. Providing and erecting Approved make Power Saving Max. 50 Watt Ceiling fan with double ball bearing ISI mark with condenser A.C. 230V.50 c/s.1200 mm. sweep complete having 3 blades with aluminium blades with canopy and 30 cms. down rod erected on existing hook or clamp with 24/0.2 , 3 core flexible wire with earthing. [5 star Rating as per list declared by BEE]

63. Supplying & erecting fan hook box of 10 mm M.S. round bar bounded to the RCC bars up to 50mm length each side and pierced through a 16 Gauge M.S. box / Heavy Duty PVC box complete erected concealed in Ceiling with necessary finishing.

64. Supplying and erecting Single phase approved make Industrial Exhaust fan suitable for medium duty ring mounted low noise operation suitable for medium duty having size

305 mm diaand 900 RPM. Cat.II

450 mm diaand 900 RPM. Cat.II

65. Supplying and erecting Single phase ALMONARD or Equivalent make Wall mounted Air Circulator having size 450mm/18 Inch with its all accessories.

66. Supplying and erecting earthen pit of minimum bore dia. 150 mm. size, approved make Safe Earthing Electrode, consisting of pipe-in-pipe technology as per IS 3043-1987, made of corrosion free galv. pipes, having outer dia. of 50 mm., having 80-200 micron galvanizing, inner pipe dia. of 25 mm., having 200-250 micron galvanizing, connection terminal dia. of 12 mm., with constant ohmic value, surrounded by highly conductive compound with high charge dissipation, suitable for the following type of applications.

Length of pipe : 3.00 mts.

Backfilling compound : 02 nos. bags of 25 Kgs.

67. Pipe type earthing having 150 cms. long and 2.5 cms. dia. galvanized iron pipe with coupling and buried in specially prepared earth pit complete with necessary 8 SWG earth wire. (for Street Light) . With using salt and charcoal / coke as required for pipe type earthing. - to be used for each Street Light

68. Providing and erecting required size Hot Deep Galvanised Iron strip for earthing

69. Providing and erecting Annealed bare Copper 8 to 16 SWG

70. Providing and erecting Hot Deep Galvanised Iron wire 8 SWG



71. Providing & erecting water cooler having storage capacity 80 Ltr. & cooling capacity 40 Ltr.per hour @ an ambient temp of 450 C. The outlet temp. of the water should drop by 150C within a hour, The water cooler should be comprising of hermetically sealed compressor, fan motor, condensing unit, water tank surrounded by evaporating, coil, thermostats, relay etc.complete with necessary inlet & outlet connection. The body of water cooler will be made from Stainless Steel.

40 Litre Storage/80 Litre Cooling

150 Litre Storage/150 Litre Cooling

72. SITC of Water Purifire Eureka Forbs Make AG 200 or Equivalent

73. Supply and fixing 2 ton A.c(BEE FIVE STAR ONLY)

74. Supply and fixing 1.5 ton A.c(BEE FIVE STAR ONLY)

75. Supplying and erecting approved make online Un-interruptible Power Supply system comprising flat cum-boost charger, static Inverter & sealed maintenance free batteries. The charger having operating capacity for input 380-430V AC & inverter having output 415V,50 Hz Ac with 0.8 load power factor with battery, over under voltage output with over load & short circuit protection equipment. The system housed in CRC sheet duly powder coated paint with following capacity & with Following size of batteries.

(D) 30 KVA Online UPS in Parallel Redundancy (i)With 64 Nos. of 12 V 100 Ah SMF batteries Equivalent Make of BPE, APC, GE

76. SITC of Cable management system on Wall with Prestige 3D Antibac provision suitable for mounting of 6A/16A , 3pin/6 pin Switch socket including all accessories like Antibac Straight Cover, Curved Cover, Joint Cover, End Cover, Angle, Tee Etc. Equivalent make of MK, Legrand

77. Supplying and erecting, commissioning and testing diesel generating set having continuous rating, 3 phase, 415 volts, 50 cycles A.C. supply comprising of a totally enclosed air/water cooled diesel engine with multi-cylinders developing suitable BHP not less than following capacity at 1500 RPM with 10% overload for one hour in 24 hours with standard accessories like fly wheel, lubricating oil cooler, "A" class governor, heavy duty fuel wheel and lubricating oil filter, oil bath air filler, lubricating oil pressure gauge, end exhaust manifold, standard set of tools with adjustable spanners, screw drivers, feeder gauge, cylinder head to cover, joint cylinder head to exhaust, element lube oil filter, 12/24 volts electric starting equipment complete with standard battery, dynamo, cut-outs, ammeter, necessary wiring, pressure gauge, starter etc and heavy duty Residential type exhaust silencer and vertical hot air duct both logged with asbestos rope, save oil trays, exhaust piping of required length, standard wall/floor mounted fuel with level indicator and piping and drip proof alternator, self excited, self regulated, screen protected, with excitation system, capable of delivering the rated system output at 415 volts, 3 phase, 0.8 PF, 50 Hz, 4 wire, running at 1500 RPM, conforming to IS-4722- 1968 with voltage regulation +/- 5% of rated voltage from no load to full load. Both the engine and alternator fitted on a common fabricated steel base plate with antivibration mounting engine and alternator both connected to each other by flexible flange coupling and with floor/wall mounted control panel box comprising of voltmeter ammeter, selector switches, ACB / MCCB / MCB of adequate capacity,

indicator lamps duly wired with HRC fuses. The alternator & control panel shall be connected with provided suitable capacity armoured cable and complete with Acoustic enclosure (canopy) made out of



18 SWG CRCA Sheet, sound absorbing material Rockwool of 64 density & 100 mm thick conforming to IS:8183 The resin bonded rockwool covered from inside the canopy by perforated sheet with 3/4 mm holes, sound level not more than 75 dB at a distance of 1 mtr, as per PVCT norms. Erection, commissioning and satisfactory testing as per requirement with first filling of fuel, oil, etc. with guarantee of complete system for One year.& with obtaining all necessary certificate from Electrical Inspector. The Capacity and Ratings of DG sets are as below

SITC of Continuous rating of 250 KVA ,BHP not less than 313 BHP at 50 °C

78. Providing & erecting approved make AMF control panel suitable for following size of 3 phase, 415 V., 50 cycles, A.C. diesel generating set complete of scope as detailed below:

1) Power module: A pair of electromechanically interlocked contactors (for mains & generator) Overload relay for generator contactor Neutral contactor for mains and generator Power socket for connections.

2) Control and metering module: Line voltage monitor. Generator voltage monitor Ammeter 3 items attempt start facility. Air circuit breakers/MCB/MCCB of suitable rating for auto/manual operation.Auto/manual switch.Emergency stop push buttons.Manual start push button.frequency meter. Engine hour meter.Two earthing studs.

3) Protection module: The engine shutdown in the unlikely event of Low lube oil pressure High cylinder head temperature. V belt failure.

4) Indicators with alarm Load on generator.

5) Indicators Load on mains Engine fails to start .Emergency stop battery charger.

The AMF Panel of following capacity

AMF Control Panel for 200 KVA/250 KVA 3 phase DG Set

79. Providing and fixing of lightning conductor are Heavy Duty type made from Low Carbon Steel having 25 mm dia. 1300 mm long, with 250 micron copper coating is carrying out on the surface, having single prong at top, with 84 mm dia. 3 mm thick copper base plate including holes etc. complete as required.

80. Providing, installing and commissioning of Low Intensity LED type Aviation Warning Light, Type 'B' with intensity of >32 Cd, conforming to ICAO regulations, Red Color solid state lamp elements (LED'S), light will burn in stationary mode with inbuilt photocell card for automatic dusk to dawn operation, Operating Voltage – 230 V AC, 50 HZ. Weather Protection-IP 65. Equivalent MAKE of AVAIDS TECHNOVATORS PVT. LTD., Alpha Lite

81. Providing & erecting open well horizontal mono block pump set with cast iron body, complete for three phase submersible motor having





[D] For 5 HP 3 phase open well horizontal mono block pump set suitable for 1350 LPM to 310 LPM @ 10 to 42 Mtr head suitable for 50/65 mm dia delivery pipe Cat II.

82. Supplying & erecting approved make 3 phase motor control cubical panel ( Star - Delta) made from 16 G. CRCA sheet duly painted with epoxy powder painted inside and outside with hinged doors and locking arrangement, consisting of suitable size of ON- OFF isolator (AC - 3/23 duty) main fuses, single phasing preventer cum water level. Guard (Complete unit), Toggle switch to by pass Single phase preventer cum WLG, indicating lamps for R- Y- B phases, over load relay, Automatic water level controller, Ammeter & Voltmeter each with two way selector switch incoming wires duly socket Crimped, Panel to be erected on angle iron frame grouted on wall as directed. Star Delta & main contactor, overload relay, thermal / Electronic Star delta cutoff timer, start - stop push buttons. The isolator overload relay & contactors of L& T, Siemens or CuttlerHamer make only. Panel to be erected on angle iron frame ground on wall.

(a) S/D up to 7.5 H.P.

83. Supplying & erecting approved make Automatic liquid level controller 6A.as per instruction of Engineer in charge on site complete with wiring connection with existing wires , with copper conductor (Size Not less than 1.5 Sq MM) from pump to upper and lower tank with ISI marked Rigid PVC Pipe.

84. SITC of Entry/Exit Signage with 5 hour battery backup, non maintain type, LED, Ni-Mh/Ni-Cd Rechargeable battery, 16 to 24 hour recharging period, constant current charging type, Confirms IS : 9583-1981 with 22 SWG CRCA white powder coated housing, Input 230V, 50 Hz. Price is include with all required accessories for mounting.Equivalent make of Prolite (PEL LED E/M)

#### 85/86/87/88. GENERAL DESCRIPTION OF LIFTS

Supplying, Erecting, Testing & Commissioning the passenger / stretcher lift having following main features:

[1] GEAR LESS LIFT DRIVE comprising of High Starting torque Lift duty 3 phase 440 V A. C. Permanent magnetic synchronous motor of proper rating with high efficiency shall be used.

[2] Micro processor based / PLC, ACVVVF, vector control drive with encoder feedback closed loop system shall be used for lift car and door operation which shall be full collective selective operation hall call demand response, UP/DOWN hall stops, Main, Up/ Down Contactor with overload and phase reversal relay and safety controls.

[3] Car with M S platform with bracings of adequate size and to sustain the impact load cabin + passenger with safety factor of fire for steel and side panels of Stainless steel of sheet of grade 304 duty. Car ceiling will be S.S. finishes with aesthetic appearance with LED ceiling lights. Car flooring shall be of anti skid PVC with choice of colour of engineer in charge. Car doors shall be of stainless steel grade 304, hairline finish with centre opening / telescopic automatic doors. Car panel will also be S.S. 304 finished with emergency stop device, mechanical door safety device, facility of auto/ attended mode. All car panel buttons and all floor switches must be with brail language as per lift act.

[4] All landing doors shall be fully automatic centre opening/ telescopic opening made of hairline finish steel grade of 304 with key holes and infrared curtains with Unlocking facility from outside.

[5] Appropriate battery operated emergency light in the car along with alarm switch shall be provided.



[6] Digital scrolling indicator system for up-down arrow along with floor position indicator shall be provided inside the car and at all floors.

[7] Full height infra red curtain with multiple criss / crossing light beams shall be provided.

[8] Automatic Rescue Device (ARD) shall be provided accordingly of passenger capacity.

[9] Audio visual indication in the lift car showing over loading shall be provided such that doors kept open till excess load is removed.

[10] Spring buffers/PU Buffers shall be provided.

[11] Car fan with automatic sleep timer shall be provided.

[12] Voice annunciater with suitable music shall be provided in lift car.

[13] Self diagnostics system for operational and safety parameters shall be provided in control panel.

[14] Mechanical over speed governor, door key holes in the floor doors, fireman switch shall be provided.

[15] Lift machine hoisting arrangement in the lift machine room and monkey ladder for lift pit should be provided by the lift agency, along with the other steel structure works, foundations for the machine etc...

[16] In the hoist way fascia plate shall be provided without any extra cost, where ever required as / if directed by engineer in charge.

[17] Permanent wiring in lift machine room and lift well with proper numbers of light points, with fixtures, exhaust fan and plug points shall be provided by the agency. Power supply of 3 phase 440 V shall be made available by department in lift machine room.

[18] Any civil/ electrical works for additional and alteration in lift shaft and machine room related to erection of lift shall be made by lift agency without any extra cost.(granite/marble fixing around all landing door openings are not in lift agency's scope.)

[19] Agency has to provide all working drawings and documents and liaison services for obtaining all necessary permission from lift inspector and other authorities.

[20] As per statutory requirement of Got. Of Gujarat lift & escalator act 2000, lift agency has to provide

1. Car top safety barricade
2. Push & talk communication system.
3. Fireman's switch operation at Ground Floor

8 / 10passengers .Ground plus 5 upper floor with Rated Speed of 1.0 m/sec with micro proce/PLC control and ACVVVF. drive,

15 /16 passengers .Ground plus 5 upper floor with Rated Speed of 1.0 m/sec with micro proce/PLC control and ACVVVF. Drive





20 passengers .Ground plus 5 upper floors with Rated Speed of 1 m/sec with micro proce/PLC control and ACVVVF. Drive (D) Add Rs. 80,000/- for the DUPLEX control for the lifts up to 10 floors and add Rs. 10,000/- for additional each floor above 10 floors.

## **ELECTRICAL INSTALLATION WORK**

### **1.0 INTERNAL WIRING**

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 etc. including fixing of light fixtures, ceiling fan, exhaust fan, wall fan etc.

### **1.1 STANDARDS**

The following standards and rules shall be applicable:

STANDARD NO.	PARTICULAR
<i>IS : 732</i>	Code of practice for electrical wiring installation (System voltage not exceeding 650 V)
<i>IS : 1646</i>	Code of practice for fire safety of buildings (General) Electrical installation.
<i>IS : 2509</i>	Rigid non-metallic conduits for electrical wiring.
<i>IS : 6946</i>	Flexible (Pliable) non-metallic conduits for electrical installation.
<i>IS : 1293</i>	3 pin plugs and sockets.
<i>IS : 8130</i>	Specifications of conduits for electrical installation.
<i>IS : 3854</i>	Switches for domestic purpose.
<i>IS : 3415</i>	Fittings for rigid non-metallic conduits.
<i>IS : 4648</i>	Guide for electrical layout in residential building Indian electricity act and rules.

All standards and codes mean the latest.

### **1.2 POINT WIRING**

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 distribution board to the earth pin / stud of the outlet / switch box and to the outlet points.



The point wiring shall be carried out in the under mentioned manner :

- 1.2.1 Supply, installation, fixing of conduits with necessary accessories, junction / pull / inspection / switch boxes and outlet boxes.
- 1.2.2 Supplying and drawing of wires of required size including earth continuity wire.
- 1.2.3 Supply, installation and connection of modular type switches, sockets, cover plates, switch plates, etc.
- 1.2.4 The point shall be complete with the branch wiring from the Switch board to the outlet point, Pre laid conduit with accessories, junction, pull, inspection boxes, control switch, socket, outlet boxes, ceiling roses, button / swan holder, connector etc.

### **1.3 POINT**

The point shall include supply, installation, connection, testing and commissioning of point as described under “point wiring”.

The point shall consist of wiring from the outlet point to the switch board as required with a connector/ plate/ ceiling rose fan box with hook socket with switch. The point shall include in addition to phase and neutral wire a FRLS PVC insulated earth continuity wire from switch to outlet. The point shall consist of the circuit wiring from LDB to outlet point through switch and/or socket, switch board as required and including the outlet points with connector, fan hook box or sockets. A point shall include in addition to phase and neutral wire a FRLS PVC insulated Earth continuity wire from LDB to the final termination at outlet points.

### **1.4 SYSTEM OF WIRING**

The system of wiring shall consist of single core, PVC insulated, 650/1100 volt grade, copper conductor FRLS wires laid through concealed Heavy / Medium duty PVC conduits as directed.

### **1.5 GENERAL**

The contractor shall submit for approval, the drawing of 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 prior to laying of conduits. Only after the drawings are approved, the contractor shall proceed the work of conduit laying.

Prior to laying and fixing of conduits, the contractor shall carefully examine the working drawings prepared by him and approved by the Consultant indicating the layout, satisfy himself



about the sufficiency of number and sizes of conduits, location of junction boxes, sizes and location of switch boxes and other relevant details. Any discrepancy found in the drawings shall be brought to the notice of the Owner's site representative. Any modifications suggested by the contractor shall be gotten approved before the actual laying of conduits is commenced.

In laying of conduits it is important that not more than two right angle bends are provided for each circuit and as far as possible. No junction box shall be provided in the entire length of conduit run for drawing of wires. Only switch outlets, lighting fixture outlets, equipment power outlets and socket outlets shall be considered for drawing of wires.

## **1.6 MATERIAL**

### **1.6.1 PVC CONDUITS :**

All non-metallic PVC conduits shall conform to IS : 9537. The conduit shall be plan and type as specified in IS : 9537 and shall be used with the corresponding accessories (Refer IS : 3419 specification for fittings for rigid non PVC metallic conduits). PVC conduits shall be rigid unplasticised, medium gauge having 1.6 – 1.8 mm. wall thickness up to 20 mm. diameter conduit and 1.8 - 2 mm. wall thickness for all sizes above 20 mm. diameter.

### **1.6.2 BOXES :**

All the boxes for switches, sockets and other receptacles, junction boxes, pull boxes and outlet boxes shall be provided. Separate screwed earth terminal shall be provided in the box for earthing purpose. All boxes shall have adequate no. of knock out holes of required diameter for conduit entry. 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. Outlet boxes to receive ceiling fan shall be fitted with adequately sized rod / hook to fix ceiling fan. The boxes shall be of minimum depth of 65 mm.

### **1.6.3 COVER PLATE:**

The cover of the boxes to receive outlet points shall be provided.

### **1.6.4 CABLES:**

- ✓ The cables shall conform to IS : 694. For all internal wiring FRLS wires of 650 / 1100 volts grade, single core shall be used.
- ✓ The conductors shall be plain annealed copper conductors complying with IS : 1554.
- ✓ The conductors shall be circular copper conductor.
- ✓ The insulation shall be FRLS PVC complying with the requirements of IS : 694. It shall be applied by an extrusion process and shall form a compact homogenous body.
- ✓ The thickness of FRLS PVC insulation shall be as set out in the relevant standards
- ✓ The cores of all cables shall be identified by colours in accordance with the following sequence.



Single phase	- Red
Three phase	- Red, Yellow, Blue
Neutral	- Black
Earth	- Green or Green/Yellow

Means of identifying the manufacturer shall be provided throughout the length of cable.

Unless otherwise specified in the drawings the size of the cables used for internal wiring shall be as follows:

In case of circuit wiring for lights, exhaust fans, convenience socket outlet points (P+N+E) :

**3 nos. of 1.5 mm.<sup>2</sup> - From switch board to outlet points**

**For Point/Independent Plug wiring above 10 mtr of Length, additional length will be added at rate of mains.**

**For point wiring in bathroom, washbasin and W/C area in residential quarters reduce overall rate by 50% of point wiring for light.**

#### 1.6.5 SWITCHES :

Switches shall conform to IS : 3854, IS : 1293 and IS : 4615. The switches shall be single pole, single or two way and shown on the drawings or as specified. They shall be of Modular type rated for 250 volt, and of full 5 / 15 A capacity. They shall be provided with insulated dollies and covers.

The switches shall be rocker operated with a quiet operating mechanism with bounce free snap action mechanism enclosed in an arc resistant chamber. The switches shall have pure silver and silver cadmium contacts. The switches shall be flush modular type. 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. The switches installed in outdoor area shall be industrial, metal clad type, and shall be provided in weather proof enclosures, complete with weather proof gasket covers.

#### 1.6.6 SOCKETS :

The sockets shall conform to IS : 1293. Each socket shall be provided with control switch of appropriate rating. The sockets shall be Modular type, rated for 250 volts, and either of full 5 A or 15 A capacity, as mentioned on the drawings.

Sockets shall be of Five / Six pin type, the Top pin being connected to earth continuity conductor. The socket shall be flush modular type. The sockets installed in machine room, plant room or wet



/ damp area shall be metal clad weather proof type. The finishing and make of all the sockets shall be same as light switch. The socket shall have fully sprung contacts and solid brass shrouded terminals to ensure positive electrical connections.

The sockets shall be provided with automatic shutters, which opens only when earth pit of the plug inserts in the socket.

The socket shall be provided with three pin plug top suitable to the socket and of the same make as socket.

## **1.7 DRAWING OF CONDUCTORS**

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 PVC 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. 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 are 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 man and cable jointers shall be employed to do joining work.

For all internal wiring FRLS PVC 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.



Maximum permissible number of 1100 volt grade PVC insulated wires that may be drawn into rigid non metallic or PVC Conduits are given below :

Size of wires Nominal Cross section Area (Sq. mm.)	Maximum number of wires within conduit size(mm)				
	20	25	32	40	50
1.5	5	10	14	--	--
2.5	5	8	12	--	--
4	3	7	10	--	--
6	2	5	8	--	--
10	--	3	5	6	--
16	--	2	3	--	6
25	--	--	2	4	6
35	--	--	--	3	5

## 1.8 JOINTS

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.** 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.

## 1.9 LOAD BALANCING

Balancing of circuit in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

## 1.10 EARTHING

All earthing systems shall be in accordance with IS : 3043 - 1985 code of practice for earthing.

## 1.11 TESTING OF INSTALLATION

Before a completed installation is put into service, the following tests shall be complied with.

### 1.11.1 INSULATION RESISTANCE

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 giga ohms of an installation, measured shall not be less than 50 mega ohms divided by the number of points on the circuit.

The insulation resistance shall be measured between

EARTH TO PHASE

EARTH TO NEUTRAL

PHASE TO NEURAL

PHASE TO PHASE

#### 1.11.2 EARTH CONTINUITY PATH :

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.

#### 1.11.3 POLARITY OF SINGLE POLE SWITCHES :

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.

#### 1.11.4 COMPLETION CERTIFICATES :

All the above tests shall be carried out in presence of client and the results shall be recorded in a 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.

### **Telephone Wiring**

Telephone wiring is to be provided for each quarter. Such telephone wiring to be

brought to a tag-block at a suitable point in ground floor. Provisions shall be kept for

suitable entry-pipe for laying incoming telephone cable.





## **TV Cabling**

Internal TV cabling shall be provided, with one outlet up to quarters. Similarly, from suitable point at Terrace floor, TV cabling shall be provided. With use of suitable splitters, such TV cabling to be connected to each quarter.

## **External Pipe Network for Laying Telephone and TV Cabling for the Colony**

Starting from a suitable room, pipe network may be provided to lay telephones/TV cables for the colony. Suitable road cross pipe and manholes to be provided for drawing such cables and their maintenance

## **2.0 DISTRIBUTION BOARDS**

### **DISTRIBUTION BOARDS (DB's)**

Distribution Boards (DB's) shall be suitable for operation on 3 Phase/single phase, 415/240 volts, 50 cycles, neutral grounded at transformer. The DB shall be minimum di-electric strength of 2.5 KV / Sec. All Distribution Boards shall manufactured by a manufacturer listed in Appendix-I.

DB's shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-13947-1993 or follow the latest amendments.

### **2.1 CONSTRUCTION FEATURES**

DB's shall be **IP 43** & made out of 16 SWG thickhigh quality CRCA sheet steel and shall be pre-treated and powder coated sheet steel used in the construction of DB shall be folded and braced as necessary to provide a rigid support for all component. DB shall be suitable for indoor / outdoor installation, wall mounting free standing type, in double door construction. The Distribution Boards shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors, Neoprene gasket, padlocking arrangement. All removable/ hinged doors and covers shall be grounded by 4.0 sq mm tinned stranded copper connectors. Distribution Boards shall be suitable for the climatic conditions. 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-1) for factory built assembled switchgear & control gear for voltage up to and including 1100 V AC.

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 DBs.

Three phase boards shall have phase barriers and a wire channel on three sides. Neutral bars shall be solid tinned copper insulated bars with tapped holes and chase headed screws. For 3 phase DB's, 3. Independent neutral insulated bars shall be provided. All DB's shall be internally pre-wired using copper insulated PVC wires brought to a terminal strip of appropriate rating for outgoing feeders.

Knockout holes of appropriate size and number shall be provided in the DB's in conformity with the location of cable/conduit connections. Detachable sheet steel gland plates shall be provided at the top / bottom to make holes for additional cable entry at site if required.

Distribution Boards shall comprises of the following:

A panel for mounting where appropriate incoming supply circuit breaker & other auxiliaries for Control & distribution as required.

Installation accessories shall be part of the DB for fixing conductor and rails for mounting MCB's and RCCB's etc..neutral bus bars & earthing bus bars required in the circuit. All busbars in the FDB shall be insulated type.

Service cable /interconnection shall be part of the Distribution Boards.

The board shall be installed at a height such that the operating is within reach of the normal human height i.e. 1.2 to 1.8 meters from finish floor level.

Degree of protection shall be IP-52 for indoor application, IP-54 for kitchen & laundry and IP-55 for outdoor application.

All three phase distribution boards shall have 4 rows and single phase distribution boards shall have single rows for housing of MCB's and RCCB's unless noted otherwise.

Phase segregation to be maintained in all three phase distribution boards.

Earthing shall be provided in each FDB's.

## **2.2 MINIATURE CIRCUIT BREAKER (MCB) & MCCB**

### **MCB**

Miniature Circuit Breaker shall comply with IS-8828-1996/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 240/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be



less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (B,C,D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values. MCB shall ensure complete electrical isolation & downstream circuit or equipment when the MCB is switched OFF.

The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP, TPN and 4 Pole miniature circuit breakers shall have a common trip bar independent to the external operating handle.

MCB should be having an integrated label holder with dual side din rail locking facility. Incoming & Outgoing should have facility for termination of Busbar& Cable separately.

Cable termination facility should be up to 35 sq. mm.

### **MCCB**

The MCCB shall be **thermal magnetic** having features of indication and protection for overload, short circuit, earth fault. MCCB should be confirming to IS 13947 or IEC-947.

### **Important Parameters**

Sr No	Parameters	Data
1.	Rated Operating Voltage	500 V
2.	Rated Insulation Voltage	1000 V
3.	Rated Impulse Withstand voltage	8 Kv
4.	Rated ultimate short ckt breaking capacity @ 415V	35 kA
5.	Rated Short time withstand current for 1sec	35kA
6.	Rated Short time withstand current for 3 Seconds	--
7.	Rated short circuit making capacity @ 440V ac	105kA
8.	Protection range for over load and short circuit	from 40% to 100%
9.	Utilization category	B
10.	Mechanical Life operations without Maintenance	4000



11.	Mechanical Life operations with Maintenance	4000
12.	Electrical Life operations @ 440V without maintenance	4000
13.	Number of poles	3 or 4 as applicable

The MCCB shall be with protections and having various setting range as below with 2NO+2NC auxiliary contacts.

Protection	Current Adjustment	Time Adjustment
Overload ( $I_r$ )	0.4 – 1 times $I_n$	Min. 5 Setting
Short circuit	1.5 – 10 times $I_r$	Min. 4 Setting
Instantaneous	1.5 – 11 times $I_n$	Fixed
Earth fault	0.2 – 1 times $I_n$	Min. 4 Setting

Following constructional features are required:

- ✚ Trip free mechanism
- ✚ Total segregation between power and front shield so as to guarantee maximum operational safety.
- ✚ Operating lever should indicate true position of contacts.
- ✚ Provision for ROH with door interlock facility and pad lock facility. Adjustable shaft for ROH.

## 2.3 RESIDUAL CURRENT CIRCUIT BREAKER CURRENT OPERATED TYPE (RCCB)

### I. System of Operation

Residual Current Circuit Breaker shall conform to IEC 61008. RCCB shall work on the principle of core balance transformer. The incoming shall pass through the toroidal core transformer. As long as the currents in the phase and neutral shall be the same, no electro motive force shall be generated in the secondary winding of the transformer. In the event of a leakage to earth, an unbalance shall be created which shall cause a current to be generated in the secondary winding, this current shall be fed to a highly sensitive miniature relay, which shall trip the circuit if the earth leakage current exceeds a predetermined critical value. RCCB shall be current operated independent of the line voltage, current sensitivity shall be of 30 / 100 mA at 240/415 volts AC and shall have a minimum of 20,000 electrical operations.

It should provide full protection as envisaged by IE rules – 61-A, 71 – ee, 73 – ee, 1985 and also rule 50 of IE rule 1956.



## II. Mechanical Operation

The moving contacts of the phases shall be mounted on a common bridge, actuated by a rugged toggle mechanism. Hence, the closing /opening of all the three phases shall occur simultaneously. This also shall ensure simultaneous opening of all the contacts under tripping conditions.

## III. Neutral Advance Feature

The neutral moving contact shall be so mounted on the common bridge that, at the time of closing, the neutral shall make contact First before the phases; and at the time of opening, the neutral shall breaks last after allowing the phases to open first. This is an important safety feature which is also required by regulations.

MCB should be having an integrated label holder with dual side din rail locking facility. Incoming & Outgoing should have facility for termination of Busbar& Cable separately.

Cable termination facility should be up to 35 sq. mm.

## IV. Testing Provision

A test device shall be incorporated to check the integrity of the earth leakage detection system and the tripping mechanism. When the unit is connected to service, pressing the test knob shall trip the ELCB / RCCB and the operating handle shall move to the "OFF" position.

### 2.4 **EARTHING**

Earthing shall be provided as per IS:3043-1987.

### 2.5 **PAINTING**

All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be of Siemens gray paint shade no. RAL-7032 of IS Code No.5.

### 2.6 **LABELS**

Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

### 2.7 **TESTING**

Testing of panels shall be as per following codes:

IS: 8623 (Part -I) 1977 for factory built assemblies of switch gear for voltages up to and including 1000 VAC.

IS: 13947 : 1993 Degree of protection



## 2.8 WIRING

In wiring a distribution panel it shall be insured that total load of various distribution panel and/or consuming devices is divided evenly between the phases and number of ways as per Consultants drawing.

## 3.0 MEDIUM VOLTAGE CABLES

### 3.1 SCOPE

This section shall cover supply of medium voltage cables.

### 3.2 STANDARDS

The following standards and rules shall be applicable :

IS : 1554	PVC insulated electric cables (heavy duty).
IS : 1753	Aluminium conductors for insulated cables.
IS : 3961	Recommended current ratings for cables.
IS : 8130	Aluminium conductors for insulated cables
IS : 7098	XLPE insulated electric cables

Indian Electricity Act and Rules.

### 3.3 MEASUREMENTS

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.

### 3.4 GENERAL

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.

### 3.5 MATERIAL

The MV cables shall be cross linked polyethylene (XLPE) insulated PVC sheathed of 1100 volts grade aluminium or copper conductor, armoured and unarmoured heavy duty, conforming to IS : 7098 Part I IS : 1988 Part I. as asked for in the schedule of quantities.



- 3.5.1 All XLPE Aluminium/Copper Power cables shall be 1100 Volts grade, multi core constructed as per IS : 7098 Part-I of 1988 as follows :
- a) Stranded Aluminium /Copper conductor of high conductivity up to 4 mm.<sup>2</sup> size, the conductor shall be solid and above 4 mm.<sup>2</sup>, conductors shall be concentrically stranded as per IEC : 228.
  - b) Cores laid up
  - c) The inner sheath should be bonded over with thermo-plastic material for protection against mechanical and electrical damage.
  - d) Armoring should be provided over the inner sheath to guard against mechanical damage. Armoring should be Galvanized steel wires or galvanized steel strips. (In single core cables used in A.C. system armoring should be non-magnetic hard aluminium Wires/Strips. Round steel wires should be used where diameter over the inner sheath does not exceed 13 mm; above 13 mm flat steel armour should be used. Round wire of different sizes should be provided against specific request.)
  - e) The outer sheath should be specially formulated heat resistant black PVC compound conforming to the requirement of type ST2 of IS : 5831-1984 extruded to form the outer sheath.
- 3.5.2 Conductor shall be of electrolytic Aluminium/Copper conforming to IS : 8130 and are compact circular or compact shaped.
- 3.5.3 Insulation shall be of XLPE type as per latest IS general purpose insulation for maximum rated conductor temperature 70 degree centigrade.
- 3.5.4 In Inner sheath laid up cores shall be bonded over with thermoplastic material for protection against mechanical and electrical damage.
- 3.5.5 Insulation, inner sheath and outer sheath shall be applied by extrusion and lapping up process only.
- 3.5.6 Armoring shall be of galvanized steel wire/flat.  
Galvanized steel flat strip / round wires applied helically in single layers complete with covering the assembly of cores.  
For cable size up to 25 Sq. mm. : Armour of 1.4 mm dia G.I. round wire  
For cable size above 25 Sq. mm. : Armour of 4 mm wide 0.8 mm thick G.I. strip
- 3.5.7 Repaired cables shall not be used.
- 3.5.8 Current ratings of the cables shall be as per IS : 3961.
- 3.5.9 The XLPE insulated cables shall conform to latest revision IS read along with this specifications. The Conductor shall be stranded Aluminium/Copper circular/ sector shaped and compacted. In multi core cables the core shall be identified by red, yellow, blue and black coloring of insulation as following.





#### CORE IDENTIFICATION :

Two core	:	Red and Black
Three core	:	Red, Yellow and Blue
Four core	:	Red, Yellow, Blue and Black
Single core	:	Green, Yellow for earthing

Black shall always be used for neutral.

- 3.5.10 The XLPE insulated 1100 Volts grade power cables shall conform to latest IS and shall be suitable for a steady conductor temperature of 70 degree centigrade. The conductor shall be stranded Aluminium/Copper as called for in the Schedule of quantities. The outer sheath shall be as per the requirement of type ST-2 of IS:5831 of 1984.
- 3.5.11 The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.
- 3.5.12 Progressive automatic in line sequential marking of the length of cables in meters at every one meter shall be provided on the outer sheath of all cables.
- 3.5.13 Cables shall be supplied in non returnable wooden drums as per IS : 10418.
- 3.5.14 Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.
- 3.5.15 The product should be coded as per IS :- 7098 Part-I as follows :-

Aluminium Conductor	A
XLPE Insulation	2X
Steel round wire armour	W
Steel strip armour	F
Steel Double round wire armour	WW
Steel Double strip armour	FF
Non-magnetic (Al.) round wire armour	Wa
Non-magnetic (Al.) strip armour	Fa
PVC outer sheath	Y

### 3.6 GENERAL



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.

The cable shall be supplied in single length i.e. without any intermediate joint or cut unless specifically approved by the client.

The cable ends shall be suitably sealed against entry of moisture, dust, water etc. with cable compound as per standard practice.

### **3.7 TESTING**

#### **3.7.1 FINISHED CABLE TESTS AT MANUFACTURER'S WORKS :**

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 alongwith supply. If specified, the cables shall be tested in presence of clients representative.

(a) **VOLTAGE TEST :**

Each core of cable shall be tested at room temperature at 3 KV A.C. R.M.S. for a duration of 5 minutes.

(b) **CONDUCTOR RESISTANCE TEST :**

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.

**Prior to dispatching cables, and at the time of delivering the cables at stores, following tests shall be carried out :-**

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.

All tests shall be carried out in accordance with relevant Indian Standard Code of practice and Indian Electricity Rules. The Vendor shall provide necessary instruments, equipments and labour for conducting the above test and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the client and results shall be recorded in the prescribed forms.

### **3.8 CABLE MARKING**

**EMBOSSING ON OUTER SHEATH :**

The outer sheath shall be legibly embossed with following legend :

ELECTRIC CABLE : 1100 V, SIZE : 3.5 C x ----- mm <sup>2</sup>.

Manufacturer's Name & year of manufacturing.

### **3.9 SEALING, DRUMMING & PACKING**

After tests at the manufacturer's works, both ends of the cable shall be sealed to prevent the ingress of moisture during transportation and storage.

Cable shall be supplied in length of 500 ± 10% meters on packed non-returnable drums of sufficiently sturdy construction.

Cables of length more than 250 meters shall also be supplied on non-returnable drums.

The spindle hole shall be 110 mm minimum diameter.

Each drum shall bear on the outside flange, legibly and indelibly in the English literature, a distinguishing number, the manufacturer's name and particulars of the cable i.e. voltage grade, 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. The drum flange shall also be marked with manufacturer's name and year of manufacturing etc.

- i. All power cables to be supplied mentioned as 'APLSTS' in the Schedule should be mass impregnated, non-draining, paper insulated lead sheathed, double steel tape armored and must comply with the latest ISI BS specifications.



- ii. All cabling materials such as cable compound, cable lugs, tapes, shall be of approved quality acceptable to the type recommended by the manufacturer of the cable for which it is and approved by the Department
- iii. Installation of all equipment shall also conform to the applicable. Codes and practice as per the IS and shall be executed to comply with the lattes Indian Electricity rules as regards the safety, earthing of equipments and other essential provisions specified therein.
- iv. Only approved make of cables shall be used. ICC and CCI will be preferred
- v. The cables shall generally be laid as per IS code of practice.

### **3.10 GENERAL RULES FOR CABLE LAYING:**

- i. Installation shall be carried out in a neat, workman like manner by skilled experienced and competent workmen in accordance with the standard ,practices.
- ii. Cables shall be laid preferably in one piece length to avoid joints. If straight joints are found necessary, these can be introduced with prior approval of the Engineer-in-charge. The cost of the straight joint however, shall not be borne by the Department, But in no case joint shall be within the conduit, G. I. pipe and duct.
- iii. Proper care should be exercised in handling the cable to avoid formation of kind etc. and should it become necessary a cable shall be bent to a radius not less than 20 times the overall diameter of the cable.
- iv. Method of installation, routing of cable etc. shall in every case be subject to the Department's approval and the contractor shall modify and or certify at no extra cost to the Department any portions of the installation which do not meet with the Department's approval. All damages to the civil and other works on this account shall be made good by the contractor at no extra cost to the Department.

The electrical contractor while notifying the building contractor for such work shall furnish the proper drawings, fully explaining the work involved or indicate at site actual work to be carried out as may be required by the building contractor. The electrical contractor shall also notify the building contractor in writing, for finishing up as required, of any such work as soon as the electrical work with respect to the same has been completed.

- v. Where cables pass through Hume pipes, contractor shall fix hard wood bushed round the cables at the ends of Hume pipes. Where the cables pass through the floors or chambers and in such other situations as the Engineer shall require, the contractor shall seal cabbie holes in a manner approved by Engineer-in- charge. Where cable pass through roads, nallahs, etc. cables must be protected by Class 'A' Hume pipe of diameter not less than 6" (15 cm).
- vi. The cable route shall be the shortest and these shall be minimum interference with built up areas, lawns etc.
- vii. Care shall be exercised for providing suitable props for supporting other service lines on earth at the time of excavation. Where cutting of a lawn become inevitable it should be with the approval of the Engineer-in-charge.
- viii. Excavation of the trenches shall be executed with vertical sides and the trenches shall be



kept as straight as possible. The exact location of each trench shall be settled by the Engineer-in-charge. On the site when the contractor is in a position to commence each portion of the work.

The trench shall be not less than 1/2 meter wide and 90 cm deep. If more, cables are to be laid, the width should be suitably increased.

- ix. After the cables are laid, the trench shall be filled in layers, the earth in each layer being well rammed by spraying water and consolidated and sufficient allowance made for settlement. The extra earth over the trench should be removed from the place of trench to a place as decided by the Engineer- in-charge at site.
- x. Ends of cables shall be properly sealed to prevent entry of moisture prior to installation.
- xi. Where it is as specified as 1/2 core cables, the 1/2 core shall be a neutral conductor having reduced section.
- xii. For all multicore cables each core and tails shall be brought out, marked and or colored in on approved manner.
- xiii. Cable termination shall be done with suitable compression brass glands in the case of PVC cables and cast iron trifurcating boxes in the case of APLSTS cables. The armour should be connected to the right main earth in building with duplicate earth wires as per the relevant IS/BS specifications.

The core insulation over each conductor shall however be retained throughout the run of the conductor up to the end where lugs shall be fitted thereon for connections. The -lugs shall be fitted by means of approved solder and flux such as a leap, and Eyre No. 7 liberally used. The joint shall be mechanically strong and pressure tested.



#### 4.0 LIGHTING FIXTURES & ACCESSORIES

The light fixtures and fittings shall be assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Project Manager.

##### 4.1 SCOPE :

Scope of work under this section shall include inspection at suppliers/manufacturer's premises at site, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting etc as required.

##### 4.2 STANDARDS :

The lighting and their associated accessories such as lamps, reflectors, housings, ballasts etc., shall comply with the latest applicable standards, more specifically the following:

General and safety requirements for Luminaries :

Part-1 Tubular fluorescent lamps	-	IS – 1913 (Part-1)
Bi-pin lamp holders for tubular fluorescent lamps	-	IS - 3323
Electronic Ballasts for fluorescent lamps – General & Safety requirement	-	IS – 13021 (Part-1)
Electronic Ballasts for fluorescent lamps – Performance requirement	-	IS – 13021 (Part-2)
Tubular Fluorescent lamps	-	IS - 2418 (Part-1to4)
Luminaries – General requirement	-	IS – 10322 (Part-1)
Luminaries – Constructional requirement	-	IS – 10322 (Part-2)
Luminaries – Screw and Screwless termination	-	IS – 10322 (Part-3)
Luminaries – Methods of Tests	-	IS – 10322 (Part-4)
Particular requirement – General purpose Luminaries	-	IS-10322(Part-5 / Sec - 1)
Particular requirement – Recessed Luminaries	-	IS-10322 (Part-5/Sec-2)



Particular requirement – Luminaries for Road and Street lighting - IS-10322 (Part-5/Sec-3)

Particular requirement – Portable General purpose Luminaries - IS-10322 (Part-5/Sec-4)

#### 4.3 LIGHT FITTINGS-GENERAL REQUIREMENTS :

- a). Fittings shall be designed for continuous trouble free operation under atmospheric conditions without reduction in lamp life or without deterioration of materials and internal wiring. Degree of protection of enclosure shall be IP-65 for outdoor fittings except bulkhead fitting. Bulkhead fitting shall be provided with IP-54 protection.
- b). Fittings shall be so designed as to facilitate easy maintenance including cleaning, replacement of lamps/ ballasts.
- c). All fittings shall be supplied complete with lamps. All mercury vapor and sodium vapor lamp fittings shall be complete with accessories like ballasts, power factor improvement capacitors, starters, etc. Outdoor type fittings shall be provided with weather proof junction boxes (IP-55) and IP-54 Control gear boxes.
- d). Each fitting shall have a terminal block suitable for loop-out connection by 1100 V PVC insulated copper conductor wires up to 4 sq.mm. the internal wiring should be completed by the manufacturer by means of standard copper wire and terminated on the terminal block.
- e). All hardware used in the fitting shall be suitably plated or anodized and passivated.
- f). Earthing : Each lighting fitting shall be provided with an earthing terminal. All metal or metal enclosed parts of the housing shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity throughout the fixture.
- g). Painting/Finish : All surfaces of the fittings shall be thoroughly cleaned and degreased and the fittings shall be free from scale, rust, sharp-edges, and burns.
- h). The housing shall be powder coated/stove-enameled or anodized as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 deg. over 12 mm dia mandrel.
- i). Metal used in BODY of lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specification of 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 burns and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

#### 4.4. LIGHT FITTINGS – SPECIAL REQUIREMENTS

##### Box Channel Type Industrial Fittings

Box type slim line channel must be in screw less construction manufactured from M.S. CRCA sheet steel powder coated with MS CRCA cover, powder coated white. Light reflection surface in Box/Channel type fittings shall be in a POLYESTER PRECOATED STEEL having a reflection factor of not less than 80%. SCREWLESS DESIGN & CONSTRUCTION Light fixtures shall be preferred due to their ease of maintenance, especially for box/channel for box/channel type fixtures.

##### Moisture Proof Industrial Fittings

Surface mounted totally enclosed moisture proof fixtures must be in polycarbonate body and diffuser with transparent prismatic interior and smooth exterior and frosted end. Fixture must be completely sealed with polyurethane double gasket to achieve IP 65 protection. Fixture is complete with CRCA steel white powder coated / enameled finish reflector.

##### 18 W / 36 W Fluorescent and 36 W CFL Low Glare Light Fittings

Recessed mounted, modular fluorescent lighting fixture made of CRCA Sheet steel powder coated (white) housing, electro chemically brightened and anodized reflector, three dimensional cross louvers with concave contours, Fresnel top at louver saddle to increase efficiency. The luminance of  $<200 \text{ cd/M}^2$  at 63 degree viewing angle in all directions so as to confirm Cat-2 classification of CIBSELG3

#### 4.5 ACCESSORIES FOR LIGHT FITTINGS REFLECTORS

The reflectors shall be made of CRCA sheet steel/aluminium /Silvered glass/Chromium plated sheet copper as required. The thickness of reflectors shall be as per relevant standards. Reflectors made of steel shall have stove enameled/ vitreous enameled/epoxy coating finish. Aluminium used for reflectors shall be anodized/epoxy stove enameled /mirror polished. The finish for the reflector shall be as specified. The reflectors shall be free from scratches / blisters and shall have a smooth and glossy surface having optimum light reflecting coefficient. Reflectors shall be readily removable from the housing for cleaning and maintenance without use of tools.

#### 4.6 LAMPS



#### 4.6.1 TLD

Lamp shall be environment friendly low pressure mercury discharge lamp with mercury content less than or equal to 5 mg. The lamp shall have minimum lumen maintenance of 85 and CRI of 85. The lamp must comply to ROSH (Restriction of Hazardous substances) and covered by WEEE. Lamp should be fully re-cyclable. The lamp should be low on maintenance with life of 40 K hours in case of electromagnetic ballast and 65 K hours in case of HF ballast up to 10% failure. The discharge glass shall be lead free.

TLD Lamps shall be minimum tri-phosphor type and have bi-pin bases. Colour spectrum of light shall be equivalent to “PHILIPS color 84 or color 86 color 82 or “OSRAM color 21 or color 11 or color 41 (as required at site)”.

The fluorescent Tubes (TLD) should have cool daylight colour designation. But Architects reserve the right to prescribe either Cool Daylight or Bright White or Incandescent Colour Designations for TLD. NO extra payment will be made over the quoted rate of bidder for this. The 36 W fluorescent tubes will have Nominal Luminous Flux of not less than 3350 lumens whether so mentioned in the Schedule of Quantities or not.

#### T 5 – HIGH EFFICIENCY ECO-FRIENDLY LAMPS

T-5 lamp shall be environment friendly low pressure mercury discharge lamp with mercury content less than or equal to 3 mg. lamp should have lowest CO<sub>2</sub> emission compared to any other comparable light source (40% less than a TL-D standard lamp, 26% less than TL-D / 80). T-5 lamp shall be 100% lead free. T-5 lamp shall be designed for operation with electronic gear and well suited for dimming. Maximum lumen output to be reached at approx 35°C in free burning position. T-5 lamp can be ignited from -15°C to + 50°C. Lamp should be fully recyclable and must comply to ROSH (Restriction of Hazardous substances) and shall be covered by WEEE. T-5 shall have 16 mm in diameter service life of TL-5 lamp should be 10% more than TL-D lamps. T-5 lamp shall have lumen efficacy of up to 104 Lux / W and shall have excellent colour rendering to En 12464 (Ra 80 to 89).

4.6.2 Compact fluorescent lamp shall have same luminous flux and power consumption as fluorescent tubes but less than half the length and more compact than U-shaped and circulator lamps. CFL shall be suitable for use with conventional control gear & standers and for HF electronic control gear. CFL lamp shall be non integral type of OSRAM / PHILIPS only.

#### 4.7 HIGH FREQUENCY ELECTRONIC BALLAST

High frequency electronic ballast shall be used with fluorescent / Compact Fluorescent Lamps wherever specified in the schedule of quantities. High frequency electronic ballast shall comply to the following:

- IEC 927, IEC 928 for 10% total harmonic distortion.
- EMI / RFI – Confirming to FCC / VDE Class A/B.



- Line Transient as per IEEE C62.41.
- Ballast Crest Factor C1.7%.
- No Stroboscopic Effect
- Constant Wattage / Light output between 240 V  $\pm$  10%.
- Circuit protection for surge current and inrush current.
- Short circuits, open lamp protection
- PF > 70 for fluorescent / T5 lamp and CFL.
- Deactivated lamp protection
- Suitable for use with single and twin lamps
- RFI < 30 MHz EN 55015
- Total Harmonic Distortion (THD)  $\leq$  10%
- Immunity to interference EN 61547
- Safety EN 60928 / IEC 928 / IS 13021 (Part I)
- Performance EN 60929 / IEC 929 / IS 13021 (Part II)
- Vibrations & Bump tests IEC 68-2-6 FC  
IEC 9001
- Quality Standard ISO 9001
- Environmental Standard ISO 14001
- DC Operation EN 60924
- Emergency Lighting Operation VDE 0108

Total System consumption (lamps + ballast) for  
1 x 28 W T-5, shall not exceed 32 W

## 5. **EARTHING**

### 5.1 **EARTHING**

The system shall be TNS with four wire supply system (R, Y, B, N and 2 Nos. E) brought from the main L T Panel. All the non-current carrying metal parts of electrical installation and all metal conduits trunking, cable sheaths, switchgear, distribution panels, light fittings and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All metal work such as pipe lines, ducts, cable trays, stair case railing etc shall be bonded to earth.

All earthing shall be in conformity with IS: 3043 1987, and the basic system of earthing shall be TNS.

### 5.2 **EARTHING CONDUCTORS**

Earthing conductors shall be of copper / GI as mentioned in schedule of quantities and shall be protected against mechanical injury and corrosion.



### 5.3 SIZING OF EARTHING CONDUCTORS

The cross sectional area of earthing conductor shall not be smaller than half of the largest current carrying conductor subject to an upper limit of 80 Sq.mm. If the area of the largest current carrying conductor or bus bar exceeds 160 sq.mm then two or more earthing conductors shall be used in parallel, to provide at least half the cross sectional area of the current carrying conductor or bus bars. All fixtures, outlet boxes, junction boxes and power circuits up to 15 amps shall be earthed with PVCinsulated copper wire.

All 3 phase switches and distribution panels up to 60 amps rating shall be earthed with 2 Nos. distinct and independent 4 mm dia copper / GI wires. All 3 phase switches and distribution panels up to 100 amps rating shall be earthed with 2 Nos. distinct and independent 6 mm dia copper / GI wires. All switches, bus bar, ducts and distribution panels of rating 200 amps and above shall be earthed with minimum of 2 no separate and independent 25 mm x 3 mm copper / GI tape.

### 5.4 CONNECTION OF EARTHING CONDUCTORS

Main earthing conductors shall be taken from the earth connections at the main L T panel to an earth electrode with which the connection is to be made. All joints in tapes shall be with four rivets and shall be brazed in case of copper and by welding bolting in case of GI, wires shall be connected with crimping lugs, all bolts shall have spring washers. Sub- mains earthing conductors shall run from the main distribution panel to the sub distribution panel. Final distribution panel earthing conductors shall run from sub-distribution panel.

Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, or its distribution panel. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to distribution panel at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord. Switches, accessories, lighting fitting etc. which are rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered as a part of the earthing conductor for earthing purposes, even though the run of metallic conduit is earthed.

The plate/pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case not less than 2.5 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.

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.



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.

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 copper / Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanized Iron clamps and Mild Steel Zinc Passivated 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.

Overlapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.

The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.

#### EARTH LEADS AND CONNECTIONS :

Earth lead shall be bare copper or Galvanized steel as specified with sizes shown on drawings. Copper lead shall have a phosphor content of not over 0.15 %. G.I strips 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 at least 8 mm away from the wall surface.

The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.

#### 5.5 PROHIBITED CONNECTIONS

Neutral conductor, sprinkler pipes, or pipes conveying gas, water or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lightning protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system. The electrical resistance measured between earth connection at the main L T panel and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate or circuit breakers, and shall not exceed 1 ohm. All switches carrying medium voltage shall be connected with earth by two separate and distinct connections. The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in G I pipe of adequate size. The



overlapping in strips at joints where required shall be minimum 75 mm. The joints shall be riveted and brazed in case of copper and by welding / bolting in case of GI in an approved manner. Sweated lugs of adequate capacity and size shall be used for termination of all conductor wires above 6 sq.mm size. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned. Equipotent bonding of all metallic structures shall be done.

## 5.6. EARTHING

The following must always be ensured in earthing system.

- All earths must be interconnected at the earth pits. This includes generator neutrals, transformer neutrals, transformer body.

Separate Earthing should be Provided for lightning protection system earths, UPS earths etc.

- Extraneous conductive parts such as gas pipes, other service pipes and ducting risers and pipes of fire protection equipment and exposed metallic parts of the building structure.

5.7 The Contractor shall get the soil resistivity test done at his own cost of the area where earthing pits are to be located before starting the installation.

## 5.8 RESISTANCE TO EARTH

The resistance of earthing system shall not exceed 1 ohm.

## 5.9 SPECIFICATION FOR HOT DIP GALVANIZING PROCESS FOR MILD STEEL USED FOR EARTHING FOR ELECTRICAL INSTALLATION

### GENERAL REQUIREMENTS

#### I. Quality of Zinc

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS:209-1992.

#### II. Coating Requirement

Minimum weight of zinc coating for mild steel flats with thickness up to 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square meter shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs, rust stains bulky white deposits, blisters.



Mild steel flats / wires shall undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing. Jointing of earthing tape shall be by welding. All joints and cut ends shall be properly painted with aluminum paint.

#### 5.10 TEST :

The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS : 3043.

The following earth resistance values shall be measured with an approved earth megger and recorded.

- 1) Each earthing station
- 2) earthing system as a whole
- 3) Earth continuity conductors

Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 5 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 client's representative.

### 6.0 Fans, Regulators and Clamps:

#### 6.1 Ceiling fans:

Ceiling fans including their suspension shall conform to \*IS 374- 1960 specification for electric ceiling fans and regulators (Revised) & to the following requirements:

- (a) All ceiling fans shall be wired to ceiling roses or to special connector boxes, to which fans rod wires shall be connected and suspended from hooks or shackles with insulators between hooks and suspension rods. There shall be no joint in the suspension rod, but if joints be avoidable then such joints shall be screwed to special couplers of 5 cm minimum length and both ends of pipes shall touch together within couplers, and shall in addition be secured by means of split pins; alternatively, the two pipes may be welded.
- (b) Fans clamps shall be of suitable design according to the nature of construction of ceiling on which these clamps are fitted. In all cases fan clamps shall be fabricated from tested new metal of suitable sizes and they shall be as close fitting as possible. Fan clamps for reinforced concrete roots shall be buried with the casting and due care shall be taken that they shall serve the purpose. Fan clamps for wood beams shall be of suitable flat iron fixed on two sides of the beam and according to the size and section of the beam one or two mild steel bolts passing through the beam shall hold both flat irons together. Fan clamps for steel joint shall be fabricated from tested flat iron to fit in rigidly to the bottom flange of the beam. Care shall be taken during fabrication that the metal does not crack while hammering to shape. Other fan clamps shall be made to suit the position, but in all cases care shall be taken to see that they are rigid and safe.

**Note :**All fan clamps shall be .so fabricated that fans revolve steadily.





- (c) Canopies on top and bottom of suspension rod shall effectively hide suspensions and connections to fan motors, respectively.
- (d) The lead-in-wire shall be of nominal cross-sectional area not less than 1.5 mm<sup>2</sup> with copper and shall be protected from abrasion.
- (e) Unless otherwise specified, the clear distance between the ceiling fan and the floor shall not be less than 2.75 m.

## 6.2 Exhaust Fans:

For fixing of an exhaust fan, a circular hole shall be provided in the wall to suit the size of the frame which shall be fixed by means of rag-bolts embedded in the wall. The hole shall be neatly plastered with cement and brought to the original finish of the wall. The exhaust fan shall be connected to exhaust fan point which shall be wired as near to the hole as possible by means of a flexible, cord, care being taken that the blades rotate in the proper direction.

## 7.0 PANELS

### General Requirements:

7.1 All distribution panels shall comply with I.E.E. Rules 60-61. A clear distance of 0.91 m meter in front of the switch board shall be kept. Where bare connections or attachments are provided at the back of the switch board the space behind the panel shall be either less than 0.299 meter or more than 0.762 main width there shall be a passage way from the furthers outstanding part of any attachment or conductor. If the space behind the switch board exceeds 0.70 main width there shall be a passage way from either end of the switch board clear to height of 1.928 m width 0- 299 m. All wiring connection shall be made neatly and securely.

7.2 For crocoites carrying more than 10 Amps, tinned cable sockets shall be used. All connections shall be so made as to form their own diagram Circuit shall be clearly numbered to correspond to wiring diagram Names of the distribution boards shall be painted as directed by the Engineer-in-charge. All the switch fuse units and isolators D.Bs. shall be complete with earthing studs lugs neutral bar link, H.R.C. fuses and of approved make.

7.3 Skeleton type panels shall have a rigid form work adequately braced and supported. The switch and distribution boards shall be neatly arranged in the frame. The details of the frame work and the arrangement of switches shall be got approved by the Engineer-in-charge before the panel is fabricated.

7.4 All cubical type panels shall have rigid supporting frames adequately braced over which sheet metal shall be nearly secured. All switches, distribution boards etc. shall be neatly arranged on the panels and all connections made from the back of switches. The panels shall be rendered dust and vermin-proof. The interior of the panels shall not be accessible to unauthorized persons.

7.5 The recess type boards shall be embedded in wall in a cupboard with a metal hinged door with locking arrangement. In all recessed conduit work all distribution boards shall be recessed. Where recessing is not possible, free standing panel may be provided as approved by the Engineer-in-





charge.

7.6 All individual components i.e. switch fuse units D.Bs. etc. shall be connected by earth continuity wire of appropriate size with the main earth bus of the panel D.B. etc. The panel switches or D.Bs. shall be earthed by not less than 2 distinctive paths to earth. Earthing of metallic parts or exposed metal shall not be effected through any structural metal work which houses the installation. Where metallic parts are not required to be earthed and are liable to become alive should the installation of the contractor become defective such metallic parts shall be separated by durable non-conducting material from any structural work.

- (a) Power panels shall be 3 phase, 4 wire, 400/230 volts for the distribution of 3 phase or single phase power loads. Lighting panels shall be 3 phase, 4 wire 400/230 - volts for single phase lighting load distribution on all 3 phase.
- (b) All panels shall be done or protected front type with no mechanical or electrical defects.
- (c) Bus bars shall be of electrolytic copper or aluminium as specified and the properly tinned sizes as indicated on applicable drawings as required.
- (d) All knock outs for branch circuits, conduit entries shall be drilled in and filled as required. For lighting panels the top and bottom cover plates shall be removable type.
- (e) Main disconnect device for all panel boards shall be of switches of disconnect type and of the size as indicated shall be mounted directly below the panel or through a short thread conduit of required size.
- (f) The main disconnect for all panel boards shall have an entry suitable for PVC armoured cable from bottom.
- (g) All panel boards shall be provided with an earthing terminal and lug for connection to the grounding system.
- (h) Temperature rise of all electrical parts shall not be more than 300°C with full load measures at room temperature.
- (i) Buses shall be securely supported so that ordinary vibrations will not cause any of the parts to become loose.
- (j) All barriers and supports of current carrying parts shall be of moisture resistant insulating material and shall not be adversely affected by arcing.
- (k) The locations of panels shown in the drawings are only tentative. Panels may be located at a place approved by the Engineer-in-charge.
- (l) All civil works connected with fixing such as grouting chasing and making good shall be the tenderer's responsibility.
- (m) Wires of adequate capacity with proper size of lugs shall be used for interconnections.
- (n) Panel should be self supported on angle channel iron frame work. It should be preferably of bolted construction in case of transportation and flexibility. The frames shall be of the required size for the mounting of the equipment on it. It shall be bolted or grouted rigidly after leveling and alignment.



- (o) The cupboard and D.B. should be of such size so to be accommodated in the existing room as per I.S. rules and IS codes of practice for installations of Medium Voltage switch gear.
- (p) Fabrication drawing showing the detailed dimensions and panels and its components indicating the frame work, earthing positioning of switches, D.Bs. cable boxes, adopter chambers etc. shall be furnished to the Engineer-in-charge for his approval. All material to be got approved by the Engineer-in-charge. Panel should be guaranteed for satisfactory operations for a period of one year after handing over.
- (q) The panel should be painted with anticorrosive paint suitable for humid and salty atmosphere on two coats of primer.

### **SPECIFICATION FOR MEDIUM / LOW VOLTAGE PANEL BOARDS**

#### **1. SCOPE**

This specification covers the requirements of design, manufacture, testing, packing and supply of Fixed / draw out type Medium Voltage Panel boards.

#### **2. CODES AND STANDARDS:**

The equipment shall comply with the requirements of latest revision of following standards issued by BIS unless otherwise specified.

IS : 5	Colours for ready mixed paints and enamels
IS : 772	AC Electricity Meters
IS : 1248	Direct acting electrical indicating instruments
IS : 2705	Current transformers
IS: 2824	Method for determining the comparative tracking index of solid insulating materials under moist conditions
IS: 3156	Voltage transformers
IS : 3231	Electrical relays for power systems protection.
IS : 3618	Phosphate treatment of iron and steel for protection against corrosion.
IS : 5082	Material data for aluminium bus bars.
IS : 5578	Guide for marking of insulated conductor.
IS : 6005	Code of practice of Phosphating of iron and steel.



IS : 8623	Factory built assemblies of switchgear and control gear for voltages up to and including 1000 V AC and 1200 V DC. Part -II particular requirements for busbartrunking systems (bus ways).
IS : 11353	Guide for uniform system marking and identification of conductors and apparatus terminals.
IS : 13703	Low voltage fuses.
IS: 13947	LV Switchgear and control gear

- 2.1 In case of imported equipments, standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable Indian standards.
- 2.2 The equipment shall also conform to the provisions of Indian Electricity rules and other statutory regulations currently in force in the country.
- 2.3 In case Indian standards are not available for any equipment, standards issued by IEC/BS / VDE/ IEEE/ NEMA or equivalent agency shall be applicable.
- 2.4 In case of any contradiction between various referred standards / specifications / data sheet and statutory regulations the following order of priority shall govern:
  - Statutory regulations
  - Data sheets
  - Job specifications
  - This specification
  - Codes and standards

### 3. GENERAL REQUIREMENT.

- 3.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.
- 3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment at least for 15 years from the date of supply.
- 3.3 Vendor shall give a notice of at least one year to the end user of equipment and EIC before phasing out the product/spares to enable the end user for placement of order for spares and services.

### 4. SITE CONDITIONS

- 4.1 The panel boards shall be suitable for installation and satisfactory operation in a pressurized substation or in substation with restricted natural air ventilation in a tropical, humid and corrosive atmosphere.
- 4.2 The panel boards shall be designed to operate under specified site conditions. If not specifically mentioned a design ambient temperature of 40° C and altitude not exceeding 1000 meters above mean sea level shall be considered.
- 4.3 All the equipment described in this specification is intended for continuous duty at the Specified ratings under the specified ambient conditions.



## 5. DESIGN AND FABRICATION REQUIREMENTS.

- 5.1 Medium voltage switchboard shall be metal enclosed fully draw out, free standing, floor mounting, compartmentalized, modular type suitable for indoor installation.
- 5.2 The switchboard enclosure shall be dust and vermin proof and shall provide a degree of protection not less than IP-41.
- 5.3 The switchboard shall be assembled out of vertical panels of uniform height in single line up.
- 5.4 It shall be possible to extend the panel boards, in either direction at a later date. Ends of bus bars shall be suitably drilled for this purpose. Panels at extreme ends shall have openings, which shall be covered with plates screwed to the panel. Details of drilled holes in bus bar and openings in the panels, provided for future extension shall be clearly shown in the vendor drawings.
- 5.5 The switchboard shall be designed to ensure maximum safety during operation, inspection, connection of cables, relocation of outgoing circuits and maintenance, with the bus bar system energized and without taking any special precautions.
- 5.6 Adequate means shall be provided to prevent shorting of power and / or control terminals due to accidental dropping of maintenance tools etc. inside the switchboard. Checking and removal of components shall be possible without disturbing adjacent equipment.
- 5.7 All identical equipment and corresponding parts shall be fully interchangeable.
- 5.8 The frame, of individual vertical panels shall be fabricated using pressed and cold rolled sheet steel. *The sheet steel used for panel shall be of minimum 2mm (14SWG) CRCA except that the doors and covers may be made of 1.6mm (16SWG) CRCA.* Wherever required, stiffeners shall be provided to increase stiffness of large size doors and covers.
- 5.9 The switchboard shall be provided with integral base frame for each vertical panel. The switchboard integral base frame shall be suitable for tack welding.
- 5.10 All openings, covers and doors shall be provided with neoprene Gaskets. Removable blanking plates shall be provided to cover the openings in the event of withdrawing the feeder modules. Number of blanking plates shall be 10% of each module size with a minimum of one number.
- 5.11 All hardware shall be corrosion resistant. All joints and connections of the panel members shall be made by zinc passivated cadmium plated high quality steel bolts, nuts and washers.
- 5.12 Suitable removable type eyebolts shall be provided for the lifting of the panel/shipping section. These bolts, when removed shall not leave any opening in the panels.
- 5.13 Non-magnetic cable gland plates shall be provided for termination of single core cables.
- 5.14 The switchboard shall be formed using distinct vertical panels each comprising of following compartments.
  - 5.14.1 A metal enclosed horizontal bus bar compartment running at top unless otherwise specified.
  - 5.14.2 Individual feeder modules in multitier mode.
  - 5.14.3 Vertical bus bars serving all feeder modules in the vertical panel.
  - 5.14.4 Cable termination compartment.
  - 5.14.5 Perforated sheet steel / insulating material enclosed horizontal auxiliary bus bars for control, interlock, indication and metering wiring running horizontally.



- 5.15 Metal sheets shall be provided between two adjacent vertical panels running up to full useful height of the switchboard.
- 5.16 MCC shall be of single/double front execution as specified in data sheet/job specification. However Circuit breaker panels and fixed type switchboard shall be in single front execution only.
- 5.17 Motor starter and switch fuse modules shall not be accommodated at front and rear of ACB Incomer and bus coupler panel.
- 5.18 All metering and protection equipment associated with a particular circuit as specified in data sheet shall be housed in separate and independent compartment earmarked for that particular circuit and in the fixed portion of the vertical panel *in case of breaker panels*.
- 5.19 All auxiliary devices for control, reset, indication, measurement and protection such as push buttons, control and selector switches, indicating lamps, measuring instruments and protective relays shall be mounted on the front side of the respective compartment. The design shall be such that all power on/off or start / stop and relay reset operations shall be performed without opening the panel door.

#### **5.20 Space Heaters**

The switchboard panels shall be provided with space heaters to prevent moisture condensation. The space heater shall be located in the bottom part of each panel and shall be supplied from 240 V AC auxiliary bus for space heater. The space heater shall be provided with a thermostat having adjustable setting and double pole miniature circuit breaker.

#### **5.21 Auxiliary Bus bars**

Auxiliary bus bars each of minimum size 18-mm<sup>2</sup> coppers shall be provided for following applications. Exact number of bus bars shall depend on various control, metering and auxiliary power distribution requirement.

5.21.1 Panel space heater supply and motor space heater supply.

5.21.2 Control supply for breaker tripping, closing and indication circuits.

5.21.3 Control supply for breaker spring charging motors, motor starter control and indication circuit.

5.21.4 AC potential supply for energy meters, voltage operated relays etc.

5.21.5 Tee-off connectors shall be used for distributing auxiliary supply to each vertical panel. Rubber grommets shall be used for all wire entries to make the entries dust and vermin proof.

5.21.6 Provision to hook up of external DC control supply to be provided either in bus PT panel or bus coupler panel.

#### **5.22 Bus Bar**

5.22.1 Bus bars shall be of high conductivity electrolytic aluminium /copper supported on insulators made of non-hygroscopic, non-inflammable material with tracking index equal to or more than that defined in Indian standards.

5.22.2 The main bus bars shall have uniform current ratings throughout their length as specified in data sheet/job specification. The current rating of the neutral shall be half that of the phase bus bars. Removable neutral links shall be provided on feeders to permit isolation of the neutral bus bar.



- 5.22.3 Both horizontal and vertical bus bars, bus joints and supports shall be capable of withstanding dynamic and thermal stresses of the specified short circuit currents for 1 second. The short circuit capacity of the neutral bus bars shall be in line with IS: 13947.
- 5.22.4 Only zinc passivated or cadmium plated high tensile strength steel bolts, nuts and washers shall be used for all bus bar joints and supports.
- 5.22.5 The hot spot temperature of bus bars including joints at design ambient temperature shall not exceed 95° C for normal operating conditions.
- 5.22.6 The current rating as defined for switchboard and components in data sheet/job specification are for design ambient temperature at site conditions and for being inside the cubicle at fully loaded condition. The vendor shall suitably derate the nominal rating to suit the above condition.
- 5.22.7 All bus bars shall be insulated with heat shrunk PVC sleeves of 1100 V grade. Red, yellow and blue colour shall be used for phase bus bars and black colour shall be used for neutral bus bars. Removable type shrouds shall be provided for joints.
- 5.22.8 Minimum clearance between live parts, between live parts/neutral to earth shall be 19 mm. However clearances between terminals at components shall be as per applicable individual standards for components.
- 5.22.9 Interconnections between the main bus bars and individual units shall be made by using aluminium bus bars of adequate rating. These interconnections of the vertical bus bars shall be in separate compartment and fully shrouded.
- 5.22.10 Vertical bus bars for circuit breaker panels shall be sized depending upon the rating and number of breakers per vertical panel. However Vertical bus bars of all other panels shall be of uniform cross section. Size of vertical bus bars shall not be less than 500 mm<sup>2</sup> Aluminium per phase or equivalent copper for panels rated above 25kA.

### 5.23 Wiring and Terminals

- 5.23.1 Inside the cubicles, the wiring for control, signaling, protection and instrument circuits shall be done with BIS approved, PVC insulated, flame retardant type, copper conductor wire. The insulation grade shall be 660 V. The wiring shall preferably be enclosed in plastic channels or neatly bunched together.
- 5.23.2 PVC insulated copper conductor of cross section 1.5 mm<sup>2</sup> may normally be used provided the control fuse rating is 10 amps or less. For 16 amps control fuse circuit 2.5 mm<sup>2</sup> copper conductor shall be used. Each wire shall be terminated at a separate terminal. C.T. Circuit wiring, shall be done with 2.5mm<sup>2</sup> Copper conductor.
- 5.23.3 Shorting links/suitable-shortening arrangement for shorting CT secondary shall be provided.
- 5.23.4 Each wire shall be identified at both ends by PVC ferrules.
- 5.23.5 Inter panels wiring within each shipping section shall be switchboard vendor's responsibility. For wiring between shipping sections, vendor shall provide terminal blocks on adjoining shipping sections and supply suitable jumpering wires. Inter panel wiring shall be taken thorough PVC sleeves or rubber grommets.
- 5.23.6 A minimum of 10% spare terminals shall be provided on each terminal block.
- 5.23.7 Conductors shall be terminated with adequately sized compression-type lugs for connection to equipment terminals and strips. Stranded conductors shall be soldered at the ends before connections are made to the terminals. Sufficient terminals shall be provided on each terminal block to ensure that no more than one outgoing wire is connected per terminal.





5.23.8 Terminal strips shall preferably be separated from power circuits by metal barriers or enclosures. All spare contacts of auxiliary relays, timers, etc shall be wired up to the terminals.

#### 5.24 Earthing

- 5.24.1 All panels shall be connected to a tinned copper earth bus bar running throughout the length of the switchboard.
- 5.24.2 The minimum earth bus size shall be 30x6 mm<sup>2</sup> copper for fault level up to 31.5 kA and 50x6 mm<sup>2</sup> copper for fault level above 31.5 kA.
- 5.24.3 All doors and movable parts shall be earthed using flexible copper connections to the fixed frame of the switchboard. Provision shall be made to connect the earthing bus bar to the plant-earthing grid at two ends.
- 5.24.4 All non-current carrying metallic parts of the mounted equipment shall be earthed. Minimum 4 nos, 10 mm diameter bolts with nuts shall be provided on the earth bus for termination of fourth core of cable per vertical panel.

#### 5.25 Name plate

- 5.25.1 A nameplate with the switchboard designation shall be fixed at the top of the central panel. A separate nameplate giving details for each feeder compartment of all panels shall be provided.
- 5.25.2 The nameplates for feeder compartments shall be in two parts. One part shall have necessary details pertaining to the compartments number of vertical panel of the panel boards. The other parts shall be removable and shall contain all details regarding the feeder number for drives/equipment controlled by the particular module as per approved single line diagram.
- 5.25.3 Blank nameplates shall be provided for all spare and vacant modules.
- 5.25.4 Nameplate or polyester adhesive stickers shall be provided for each equipment mounted inside the switchboard. Special warning plates shall be provided on removable covers or doors giving access to cable terminals and bus bars.
- 5.25.5 Special warning labels shall be provided inside the panel boards also, wherever considered necessary. Identification tags shall be provided inside the panels matching with those shown on the circuit diagram.
- 5.25.6 Engraved nameplates shall preferably be of 3- ply (Black-White Black) lamicooid sheets or anodized aluminium. However back engraved Perspex sheet nameplates may also be acceptable. Nameplates shall be fastened by screws and not by adhesives.

#### 5.26 Painting

- 5.26.1 All metal surfaces shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under surface shall be prepared by applying a coat of phosphate paint and coat of yellow zinc chromate primer. The under surface shall be made free from all imperfections before undertaking the finishing coat.
- 5.26.2 After preparation of the under surface, the switchboard shall be spray painted with two coats of epoxy based final paint or shall be powder coated.
- 5.26.3 Colour shade of final paint shall be 631 as per IS:5 unless otherwise specified.





- 5.26.4 The finished panels shall be dried in stoving ovens in dust free atmosphere. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint etc. Vendor shall supply final paint (1 liter per switchboard) in non-returnable container for final touch up at site.
- 5.26.5 All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust formation. If these parts are moving elements then they shall be greased.

## **6. SPECIFIC REQUIREMENTS OF AIR CIRCUIT BREAKERS PANELS**

- 1.1 The breaker panels shall have distinct bus bar, breaker and cable compartments.
- 1.2 The design of each compartment shall be such as to prevent movement of vermin from a particular compartment to any other compartment of the panel when the breaker is withdrawn and compartment door is closed.
- 1.3 Blanking plates shall be provided for each circuit breaker compartments, which would be used after installation, to cover the openings in the event of taking out the breaker outside the compartment.
- 1.4 In order to minimize accidental access and avoid accidents due to falling tools, all the outgoing links shall be shrouded.
- 1.5 Outgoing Air circuit breaker can be mounted in a maximum of two-tier execution while the incoming/bus coupler Air circuit breaker shall be in single tier execution only.
- 1.6 **Cable compartment**
- 6.6.1 Separate compartment totally enclosed from all sides shall be provided for cable termination, on the rear side. Access to cables shall be from the rear side after opening the cabling compartment door.
- 6.6.2 The incoming / outgoing cable termination shall be staggered for each circuit and barriers of sheet steel or insulating material shall be provided between termination of two circuits such that maintenance on one circuit could be carried out while the other circuit is live. Suitable clamping arrangements shall be provided for cables and cable termination. Terminal blocks shall not be used for supporting the cables.
- 6.6.3 The incoming supply for PCC/ PMCC panels shall be through top entry bus ducts or through bottom entry cables unless specified otherwise. The outgoing cables shall have bottom entry unless specified otherwise.
- 6.6.4 The cable terminations shall be suitably sized for receiving specified number of cables per termination and provision shall be made for terminating each outgoing cable with a separate bolted connection. In case the total number of cables entering a particular panel cannot be accommodated in the cabling compartment of the panels an extension panel of full height shall be added to the cabling compartment for accommodating extra cables.
- 1.7 **Circuit breaker compartment**
- 6.7.1 The circuit breaker compartment shall be fully draw out. Suitable guides shall be provided to facilitate easy withdrawal of the circuit breaker.
- 6.7.2 The current transformers for the ammeter/protection circuits shall be mounted on the fixed portion of the compartment. However, current transformers associated with built-in releases may be mounted on the breaker trolley.



- 6.7.3 All terminals except wiping/sliding type control terminals shall be shrouded with plastic covers to prevent accidental contact. For direct termination - clip on shrouded type terminals shall be provided.
- 6.7.4 There shall be three positions for the draw out trolley viz:
- "Service" position - In this position both power and control circuits shall be connected. This shall be the normal operating position of the circuit breaker.
  - "Test" position - The power contacts shall be disconnected in this position but the control connections shall not be disturbed, it shall be possible to close and trip the breakers in this position.
  - "Draw out" Position - both power and control circuits shall be disconnected in this position and breaker removed from the cubicle.
- 6.7.5 The circuit breaker shall be lockable in "service" and "test" positions. Safety shutters shall be provided when the breaker is in withdrawn/draw out position.
- 6.7.6 The earth connection must remain connected in "Test" position; Earthing of the unit shall be done with a "pin" or with scrapping earth connections.
- 6.7.7 The earth connection shall make before the main power / control contacts make and break after the power /control contacts are disconnected. Earthing connection through a plug and socket connection shall not be acceptable

## 1.8 Interlocks

Following interlocks shall be provided:

- 6.8.1 Compartment doors shall be interlocked against opening when breaker is in closed condition. However, it shall be possible to defeat this interlock for inspection purposes.
- 6.8.2 It shall not be possible to push "in" a drawn out circuit breaker in closed condition or withdraw a circuit breaker in closed condition.
- 6.8.3 It shall be possible to operate a circuit breaker only in the defined "Full in" or "service" and "test" position inside the panel. It shall not be possible to operate the breaker in intermediate positions while inserting or withdrawing circuit breaker.

- 1.9 Any unused circuit breaker compartment shall be fully equipped and provided with compartment door, vertical busbars and control terminals/ wiring etc. such that the same could be used for housing outgoing breakers in future without any modifications to the panel.

## 7. SPECIFIC REQUIREMENTS OF AIR CIRCUIT BREAKER FEEDERS

- 7.1 The design of draw out feeder modules shall not change for single front or double front execution. Separate vertical bus bars shall be provided for each front side modules.
- 7.2 All identical feeder modules shall be interchangeable.
- 7.3 Each vertical panel shall have a separate cable alley. The width of this cable alley shall be sufficient to accommodate all the cables and shall have free access for cable terminations and in any case shall not be less than 200mm minimum. Cable alleys shall be provided with suitable doors.
- 7.4 Sheet steel barriers shall be provided between individual compartments and cable alley. This barrier shall be provided with opening for power and control connections and it shall be possible to safely carryout maintenance work on cable connections to any one circuit in the cable alley with the busbars and the adjacent circuits live.



- 7.5 Maintenance and connection of cables to any modules shall be possible without having to take out the modules from its position from the panel.
- 7.6 The outgoing feeder trolleys for draw out type switchboard shall be fully draw out and shall have the following features.
- 7.6.1 It shall be possible to withdraw the trolley without having to unbolt or unscrew any power and control connections to the equipment mounted on the withdraw able trolley.
- 7.6.2 Both power and control connections shall be draw out type. All line and bus PTs shall be in draw out execution only. However, outgoing modules having size more than half of the useful vertical height of the panel may be in mixed combination of draw out /fixed type.
- 7.6.3 Control supply transformer modules with burden higher than 2.5KVA may be in fixed execution.
- 7.6.4 The trolley withdrawal shall be by means of crank and screw arrangement. Alternatively movement on guided rollers may also be acceptable. Plug in operation shall be independent of manual force.
- 7.6.5 For drawout type feeders of size equal to or greater than half the useful vertical height of panel, positive clamping arrangement shall be provided on the top portion of the trolley in addition to clamping arrangement at the bottom, to ensure all round positive pressure on the power draw out contacts once the trolley is plugged in.
- 7.6.6 Power draw out contacts shall preferably be located towards the bottom portion of each trolley. The trolley shall be lockable in fully plugged in position and devices shall be provided to ensure positive plugging in. In test position, power contacts shall be totally isolated and a device shall be provided for indication of test position.
- 7.7 The incomer and bus tie feeders with load break switches rated 800A and above may be in fixed execution.
- 7.8 Various compartment sizes in a *vertical* panel shall be multiples of a basic dimension. However the minimum module size for switch fuse feeder and motor starter/contactors feeder shall not be less than that defined in data sheet/job specification. Vertical bus bars shall be pre-drilled at regular intervals for complete flexibility for changes in size of modules.
- 7.9 All switch drives other than rotary control switches, shall be lockable in both 'ON' and 'OFF' positions.
- 7.10 The switches/Moulded case circuit breakers /MCB shall be interlocked with the compartment door to prevent opening of the door when the switch/moulded case circuit breaker is in 'ON' position and to prevent switching on when the door is open. A defeat mechanism for this interlock shall also be provided.
- 7.11 The maximum height of the operating handle and switches shall not exceed 1900 mm and the minimum height not below 300 mm.
- 7.12 Unused modules in the panel shall be fully equipped with hinged door, power and control terminals for starter modules and cradle for future use.

## 8. SWITCHGEAR MODULES



- 1.1 Switchboard shall be completely lined up in one straight row with the type and quantities of feeders as defined in switchboard data sheet. Generally the feeders of three main categories are identified as circuit breaker, motor starters and switch fuse.
- 1.2 Type of modules for fixed type switchboard shall be similar to above specified draw out modules except that the modules shall be of fixed type.
- 1.3 Minimum 2000 VA control transformer shall be provided for each bus section of the PMCC/MCC switchboard having contactor control feeders and each transformer shall be sized for the entire switchboard. For switchboard having two bus sections and coupled by bus tie shall have manual changeover switch for the control transformers.

## **9. SWITCHBOARD COMPONENTS**

### **9.1 Circuit breakers**

- 9.1.1 The circuit Breaker shall be air-break, horizontal draw-out feature shall show positions viz: SERVICE, TEST and ISOLATE. These positions along with 'OPEN' and 'CLOSE' positions shall be visibly marked.
- 9.1.2 All positions shall have provisions for locking. The ACB shall have shutter assembly and arches and mechanical trip features.
- 9.1.3 The ACB shall have 6 NO + 5 NC auxiliary contacts rated at 10A, 240 V, AC.
- 9.1.4 'RED' and 'GREEN' indicating lamps shall be provided on the cubicle.
- 9.1.5 The ACB door shall not have any lamps or instruments. All such accessories shall be mounted on a separate compartment.
- 9.1.6 The ACB shall have proper interlocks such that it cannot be plugged in or out 'SERVICE' position, if the breaker is in 'ON' condition. It shall not be possible to operate as circuit breaker unless it is properly engaged in any of the three positions.
- 9.1.7 The ACB shall have series CT operated over-current and short-circuit releases with facilities to mount the under voltage and shunt-trip releases.
- 9.1.8 The operating mechanism shall be independent, manual spring charged stored energy type. The mechanism shall ensure quick-break, quick make action and the ACB shall be trip-free in operation.

### **9.2 LV switchboard changeover automatism**

Changeover switchboard shall be equipped with remote operated source changeover system associated to an automatic controller allowing automatic source control according to programmable operating modes.

The remote operated source changeover shall include:

a mechanical interlocking system,  
an electrical interlocking system.


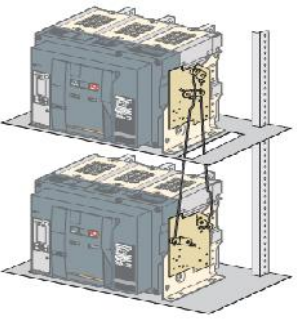

#### **9.2.1 Mechanical interlocking system**

For switchgear from 100 A to 630 A, the mechanical interlocking system shall be implemented on a mounting rail dedicated to 2 fixed or plug-in switchgear for horizontally or vertically installation. These switchgear may be implemented with or without earth-leakage protection or measurement modules.

For switchgear above 630 A, the mechanical interlocking shall be implemented:

by using connecting rods, in that case they shall be mounted one above the other,  
Or by using cables, in that case they can be mounted one above the other or side- by-side.

The interlocked devices may be fixed or draw out, three-pole or four-pole, and have different ratings and sizes.

Switchgear between 100 A et 630 A	Switchgear > 630 A	
Mounting rail interlocking	Connecting rods interlocking	Cables interlocking
		

### 9.2.2 Electrical interlocking system:

The electrical interlocking shall implemented by a unit integrating control circuits and an external terminal block. The integrated control circuits implement the time delays required for correct source transfer.

An automatic controller may be added to take into account information from the distribution system.

#### Automatic source controller

This controller shall provide the following functions:

- transfer from one source to another depending on the presence of voltage on the “Normal” source,
- startup of an engine generator set,
- shedding and reconnection of non-priority circuits,
- transfer to the “Replacement” source if one of the phases on the “Normal” source fails.

This controller shall remote the following information:

- circuit breaker status (ON, OFF, fault trip),
- presence of the “Normal” and “Replacement” voltages,



presence of an order for forced operation,  
settings and configuration information,  
status of non-priority circuits (loads shed or not),  
position of the switch (stop, auto, forced operation on the “Normal” source, forced operation on the “Replacement” source).

### **9.3 FUSES:**

- 9.3.1 All fuses shall be of HRC cartridge fuse-link type having a certified rupturing capacity of not less than 46kA at 415 volts AC.
- 9.3.2 The HRC fuses shall conform to IS 9224 1979.
- 9.3.3 All fuses shall have visible indication to indicate ‘Blown’ condition.

### **9.4 HRC Fuse Carriers :**

- 9.4.1 The HRC fuse carriers/bases shall be of high grade phenolic molding.
- 9.4.2 The contacts shall be silver-plated and contact blocks shall be suitable to receive the rated conductors of aluminum.
- 9.4.3 The fuse carriers shall have an aperture to view the conditions of HRC fuse mounted inside.

### **9.5 Contactors :**

- 9.5.1 The motor starter contactor shall be of the electro- magnetic, double-break, non-gravity type rated for uninterrupted duty suitable for operation under AC-3 utilization category as per IS 2959. The contacts shall be silver plated.
- 9.5.2 2 NO and 2 NC auxiliary contacts shall be included.
- 9.5.3 The operating coil shall have class ‘E’ insulation of wire and shall be suitable for operation of any specified control supply system.

### **9.6 Thermal Overload Relays :**

- 9.6.1 The thermal overload relay shall be 3 element, positive action, ambient temperature compensated with a time lag and adjustable settings. The setting range shall be selected in accordance with the ratings of the motor.
- 9.6.2 The relay shall be self-reset/hand reset as called for. In the case of hand-reset, the reset button shall be fixed on the compartment door.
- 9.6.3 The relay shall have at least one ‘NC’ and one ‘NO’ or one changeover contact.

### **9.7 Moulded Case Circuit Breakers:**

- 9.7.1 The moulded case circuit breakers, MCCB shall be provided where specified. The MCCB shall conform to the latest applicable IS 2516 - 1977.
- 9.7.2 For AC Circuits the MCCB shall be triple pole construction and shall have independent manual opening and closing mechanism. The mechanism shall be quick-make and





quick-break type and the breakers shall be trip-free in operation. The 'ON', 'OFF' and 'TRIP' mechanisms shall be clearly indicated.

- 9.7.3 Bolted type neutral link to be provided with TP MCCB.
- 9.7.4 It shall be possible to mount accessories on the MCCBs like shunt-trip and under voltage release, alarm contacts, etc.
- 9.7.5 The MCCB's shall have thermal/static trip devices.
- 9.7.6 The MCCB's shall have rupturing capacities as specified in BOQ/Single Line Diagram.
- 9.7.7 All MCCBs shall be provided with rotary handles for operation with padlocking facility.
- 9.7.8  $I_{cs}$  shall be equal to 100% of  $I_{cu}$  and shall be equal to  $I_{cw}$ . The breakers shall be of Utilization category B as per IEC.

## 9.8 Miniature Circuit Breakers :

- 9.8.1 The MCBs shall be of single pole, double pole, triple pole or four poles as required.
- 9.8.2 The MCBs shall be of magnetic type with a maximum rupturing capacity of 10 kA at 415 V.
- 9.8.3 The curve shall be C or D curve as required

## 9.9 Relays:

- 9.9.1 Type of relay shall be numerical, static or electromagnetic type as specified in the data sheet /job specification.
- 9.9.2 All electromagnetic protective relays shall be back connected, of draw out type, suitable for flush mounting, and fitted with dust-tight covers. Alternatively, "plug-in" type relays will also be acceptable. Auxiliary relays are acceptable in fixed execution.
- 9.9.3 The protective relay cases shall have provision at the front for "testing and calibration" purposes. It shall be possible to test the relays without disconnecting the wiring and without withdrawing the relays. The insertion of the test plug shall automatically short circuit the CTs and permit extension of external power supply to the relay.
- 9.9.4 Each protective relay shall be provided with minimum 2 nos. potential free contacts of required configuration.
- 9.9.5 Each tripping relay shall be lockout type with hand reset coil cut-off contact. The tripping relay shall be suitable for satisfactory operation from 50 % to 110 % of the specified control supply voltage.
- 9.9.6 Protective relays shall be preferably mounted on the front side and upper part of the panel and mounting of relays on the lower portion shall be avoided.

## 9.10 Instrument transformers (CTs/PTs)

- 9.10.1 Current transformers shall generally conform to IS: 2705 and any special requirement with respect to Numerical relay shall be taken care by the vendor.
- 9.10.2 For general guidance the vendor shall note that the protective current transformers shall have an accuracy class "5 P" and an accuracy limit factor greater than "10". However CTs for restricted earth fault shall be of class "PS". Vendor shall co-ordinate the knee point voltage, magnetising current for PS class CTs to avoid saturation and mismatching of CTs provided at other end by other vendor.





- 9.10.3 Current transformers for instruments shall have an accuracy class 1.0 and accuracy limit factor less than 5.0. However accuracy class of 3.0 is acceptable for CT's meant for remote ammeters.
- 9.10.4 The current transformers in breaker feeders shall be capable of withstanding the applicable peak momentary short circuit and the symmetrical short circuit current for 1.0 second.
- 9.10.5 The voltage transformers shall be cast resin type transformers and PT shall generally conform to IS: 3156. PT shall be provided with HRC fuses on primary side and Miniature circuit breakers with auxiliary contact on the secondary side.

### **9.11 Measuring instruments**

- 9.11.1 All measuring instruments shall be of 96 x 96 mm and 72 x 72 mm square pattern, flush mounting type for incomer and outgoing feeders respectively in the switchboard.
- 9.11.2 All auxiliary equipment such as shunts transducers, CT's PT's etc. as required shall be included in the supply of the switchboard.
- 9.11.3 All AC ammeters and voltmeters shall be of moving iron type with accuracy class of 1.5 as per IS: 1248. Ammeters for motor feeders shall have a non-linear compressed scale at the end to indicate motor starting current and red mark for the full load current.
- 9.11.4 The KW/KWH meters shall be suitable to measure unbalanced loads on 3 phases 4-wire system. Test terminal block shall be provided for KWH meters. The accuracy class of KW/KWH meters shall be a minimum of 2.5.
- 9.11.5 Digital meters shall be provided if specified in job specification/data sheets. All digital meter shall be high reliable, accurate, compact and self powered. Digital meter data shall be saved in case of power failure. Field programming from front of the meter shall be possible and shall be RS232/485 port in case specified in the job specification/data sheet.

### **9.12 Control switches :**

- 9.12.1 All control switches shall be rotary type, having a cam operated contact mechanism. Switch shall have pistol grip handles for circuit breaker control and knob type handle for other applications.
- 9.12.2 Ammeter selector switches shall have make before break feature on its contacts. The selector switch shall generally have 4 positions for reading 3 phase currents and fourth position for off. The voltmeter selector switch shall also have 4 positions. Three positions shall be used to measure phase-to-phase voltage and fourth shall be OFF position.

### **9.13 Push buttons:**

Push button colours shall be as follows:

- |                      |         |
|----------------------|---------|
| Stop /open/emergency | : Red   |
| Start/close          | : Green |



Reset/test : Yellow / Black /white

#### 9.14 Indications:

9.14.1 Clustered LED type indicating light with minimum 8mm diameter size shall be provided for indications.

9.14.2 Breaker positions (Close, Open, spring-charged, test position, service position) electrical indications, with colors as given below, shall also be provided:

Breaker 'Close'	: Red lamp
Breaker 'Open'	: Green lamp
Breaker auto-trip	: Amber lamp
Trip circuit healthy	: White lamp
Spring charging	: Blue lamp

9.14.3 Outgoing feeder (Close, Open, trip) electrical indications, with colors as given below, shall also be provided:

'Close'	: Red lamp
'Open'	: Green lamp
' Trip'	: Amber lamp

#### 9.15 Auxiliary relays/contactors

Auxiliary relays/contactors shall generally be used for interlocking and multiplying contacts. Auxiliary contact shall be capable of carrying the maximum anticipated current.

#### 9.16 Timers

For re-acceleration duty, timers unless otherwise stated, shall be pneumatic type and shall have adjustable time setting of 0-60 seconds. Alternatively static timer may be considered. The time settings, where specified, shall be accurately set before despatch of the switchboard. Timer provided for control of capacitor feeder shall have minimum setting of 0-5 minutes.

#### 9.17 INSPECTION, TESTING AND ACCEPTANCE

9.17.1 During fabrication, switchgear shall be subject to inspection by ELL/ Owner or by an agency authorized by the owner. Manufacturer shall furnish all necessary information concerning the supply to EIC / owners inspectors.

9.17.2 All routine and acceptance tests shall be carried out at manufacturer's work under his care and expense.

9.17.3 Type tests, if specified shall be performed. Short circuit test shall be performed at CPRI or equivalent approved testing agency and heat run test may be performed at manufacturer's works. Heat run test shall be performed at least on one incomer and two outgoing vertical panels of the ordered switchboard.



9.17.4 Type and shop tests shall be witnessed by an inspector of EIC / Owner or of an agency authorised by the owner. Prior notice of minimum 4 weeks shall be given to the inspector for witnessing the tests.

## 9.18 PACKING AND DESPATCH

All the equipment shall be divided into several shipping sections for protection and ease of handling during transportation. The equipment shall be properly packed for selected mode of transportation i.e. by ship/rail or trailer. The panels shall be wrapped in polyethylene sheets before being placed in wooden crates /cases to prevent damage to the finish. Crates /cases shall have skid bottoms for handling. Special precaution notations such as Fragile, This side up, center of gravity, weight, Owner's particulars, Purchase number etc. shall be clearly marked on the package together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing should be suitable for outdoor storage in areas with heavy rains and high ambient temperature unless otherwise agreed.

GENERAL REQUIREMENTS FOR AUTOMATIC POWER FACTOR CORRECTION PANEL  
Following PFC shall meet the following requirements.

Parameters	STANDARD DUTY
Standards	IS 13340-1993, IS 13341-1992, IEC 60831-1+2
Rated Frequency	50Hz
Rated Voltage	415 / 440V (other ratings on request)
Overvoltage	+10% (12h/24h), + 15% (30m/24h), +20% (5m), +30% (Im)
Overcurrent	1.5 X In
Peak Inrush Current	150 X In
Operating Losses ( Dielectric )	0.2 W / kVAr
Operating Losses ( Total )	0.45 W / kVAr
Tolerance on Capacitance	- 5 / + 10%
Test Voltage (Terminal-Terminal)	2.15 X Un (AC), 10 sec
Test Voltage (Terminal-Casing)	660V, 3000V (AC), 10 sec : > 660V 6000V (AC), 10 sec
Degree of Protection	IP31
Ambient Temperature Category	-5/C (maximum 55°C), other categories on request
Cooling	Naturally air cooled (or forced cooled)
Permissible Relative Humidity	95%
Maximum Operating Altitude	4000m above sea level



Mounting & Earthing	Vertical, earthing provision on enclosure
Safety Features	Pressure Sensitive Disconnecter, Self
	Healing, Protective steel enclosure
Impregnation	Non PCB, Bio degradable PU Resin
Casing	Steel enclosure
Dielectric Composition	Biaxially Oriented Polypropylene Film
Terminals	Bushing terminals designed for large size
	cable termination and direct busbar
	mounting for banking
Discharge Resistors / Time	Discharge Resistors fitted, Standard
	discharge time 60 seconds, Other
	discharge time on request

#### **Switch fuse Units:**

- (a) All the D.P.T.P and T.P.N. switch fuse units shall be totally enclosed iron clad quick make, quick break type to best Indian make conforming to the I.S. or B.S. 3185 specifications. All the switch fuse units shall have mechanical interlock with a door, so that the door cannot be opened when the switches are in 'ON' position, The switches should be of double break solution type to ensure safely.
- (b) Each T.P. & T.P.N. switch fuse unit shall be earthed with two distinct each connections.
- (c) Suitable insulator shall be provided between phase.
- (d) There shall be suitable natural link in the fuse box.
- (e) All T. P. & T. P. N. switch fuse units shall be rated for 500 volts and D. P. (required for single phase supply) and S.P.N. switches for 250 volts.
- (f) The H.R.C. cartridge fuse shall conform to H.S. 88 (1952).

The O.C.Bs., ACB shall be suitable for 400/440 volts 3 phase 50 cycle supply capable of



interrupting a fault MVA of not less than 31. The circuit breaker shall conform to the BSS-936-1940 BSS 3659 with such tripping arrangement as may be required under special specifications for the building. Efficient and fool-proof mechanical interlocking shall be provided for the safe operation and maintenance. The rate shall be inclusive of the first filling of oil.

### **Instrumentation:**

The instruments and meters wherever necessary shall be housed in special sheet steel box located between switch fuse units and bus bar chambers. The instruments etc. shall be mounted on the hinged cover with their dial flushed. All instruments shall have protective H. R. C. fuse links. All interconnections and small wiring shall be neatly dressed arranged and duly colored for easy identification of circuits.

Meters shall be provided as required in the Schedule, meters shall be dead head and be suitable for 400/440 volt 3 phase 4 wire 50 cycle (in balanced load) supply.

Each selector switch shall be 3 point and of minimum 250 volts grade with silver tipped contacts suitable for metering circuits, current transformers shall be of 5VA burden and commercial metering accuracy. Indicating lamps shall be panel mounting type preferably of 250V grade. Every unit shall be prewired and interconnected to the system for its required indicating performance. Indicating lamps shall have independent circuit fuse.

## **8.0 CABLE TRAY & TRAY SUPPORTS**

This section relates to specifications for supply, assembly, installation & connection of LT system Cable trays & tray supports

### **Ladder type cable tray**

8.1 Ladder type cable tray shall be fabricated out of double bended channel section longitudinal members with single bended channel section rungs of cross member welded to the base of the longitudinal members at a center to center spacing of 250mm. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanized or painted to the desired lengths. No welding shall be allowed at site.

8.2 Typical, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works – Part II – External, 1994.

8.3 The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler and cable tray shall be scraped and removed before the installation.



8.4 The permissible uniformly distributed load for various type of cables trays and for different supported span shall be as per CPWD General Specification of Electrical Work Part – II 1994. The sizes shall be specified considering the same.

8.5 The width of the cables tray shall be chosen so as to accommodate all the cables In one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 1000mm.

8.6 Factory fabricated bends, reducers, tee / cross junction. Etc shall be provided as per good engineering practice. The radius of bends, junctions etc. shall be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

8.7 The cable tray shall be suspended from the ceiling slab with the help of 10 mm dia MS round or 25 mm x 5 mm flats at specified spacing. Flat type suspenders may be used for channels up to 450 mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angle 50 mm x 50 mm x 5mm at the bottom and as specified These shall be grouted to the ceiling slab at the other and through an effective means, as approved by the Engineer – in – charge, to take the weight of the cable tray with the cables.

8.8 The entire tray ( except in the case of galvanized type ) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

8.9 The cable tray shall be bonded to the earth Terminal of the switch boards at ends.

8.10 The cable tray shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc, and paid for accordingly.

8.11 Cable trays shall be galvanized as per Specification given elsewhere.

- a. 1000 mm wide  
Runners 25 x 100 x 25 x 3 mm  
Rungs 20 x 40 x 20 x 3 mm 250 mm C/C  
Suspenders 2 Nos. 40 x 40 x 5 mm GI angle 1200 mm C/C
- b. 750 mm wide  
Runners 20 x 75 x 20 x 2.5 mm  
Rungs 20 x 30 x 20 x 2.5 mm 250 mm C/C  
Suspenders 2 Nos. 32 x 32 x 5 mm GI angle 1200 mm C/C
- c. 600 mm wide  
50 X 50 X 6 mm M.S. angle both side  
Runners 25 X 6 mm 250 mm C/C  
Suspenders 2 Nos. 32 x 32 x 5 mm GI angle 1200 mm C/C
- d. 450 mm wide  
50 X 50 X 6 mm M.S. angle both side  
Runners 25 X 6 mm 250 mm C/C  
Suspenders 2 Nos. 25 x 25 x 4 mm GI angle 1200 mm C/C



- e. Supply and fixing of perforated type cable trays of the following sizes of galvanized hot dip iron.
- i. 300 x 25 x 2 mm thick
  - ii. 110 x 25 x 2 mm thick

Note: Suitable length of 8 mm dia GI rod suspenders at 1200 mm intervals for perforated type cable tray.

### **8.12 HOT DIP GALVANIZING PROCESS FOR MILD STEEL USED FOR EARTHING, CABLE TRAYS OR JUNCTION BOXES FOR ELECTRICAL INSTALLATION.**

#### **8.12.1 Quality of Zinc**

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS: 209-1992.

#### **8.12.2 Coating Requirement** Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square metre shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

#### **8.12.3** The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs, rust stains bulky white deposits, blisters. Mild steel flats / wires shall undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing.

### **8.13 SUPPORT STRUCTURAL STEEL WORK**

8.13.1 The scope of this section comprises of supply/ fabrication, delivery, store at site, the support steel structure, fix and erect in proper position required for any kind of equipment / panel / cable trays etc.

8.13.2 All MCB DB's, Panels, cable trays and other electrical equipments shall provided with steel supporting or mounting frames.

8.13.3 All mounting frames shall be manufactures out of minimum 25 x 3 mm angle. Cable trays supports shall be fabricated as per load bearing capacity required and minimum of 50 x 50 x 6 mm angle.

8.13.4 All support steel mounting frame shall be cleaned by metal brush and painted by two coats of red-oxide primer and 2 coats of synthetic enamel paint of approved shade.

8.13.5 Supporting & mounting arrangements shall be got approved from Owner / Architect / Consultant from time to time.

8.13.6 The supporting holes etc should be made with proper drilling machines before painting / welding.





### **Conformity to IE Act, IE Rules, and Standards**

All Electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 2003 and Indian Electricity Rules, 1956 amended up to date (Date of call of tender unless specified otherwise). List of Rules of particular importance to Electrical Installations under these General Specifications is given in Appendix C for reference.

## **1.0 PLANNING OF ELECTRICAL INSTALLATION**

### **1.1 Planning of Electrical Installation**

The design and planning of an electrical installation involve consideration of all prevailing conditions and is usually guided by the requirement of the consumer. A competent Electrical Engineer should take the responsibility of detailed designing and planning to meet the requirement of various functional needs, efficiency, economy, energy conservation, aesthetics, appropriate technology, safety and avoidance of possible fire hazards.

#### **Coordination**

1.2.1 Before planning is started, coordination and collaboration is needed amongst the following:

Client/ / Civil contractor / Structural Engineer/ Architect / PMC / Electrical Designer

1.2.2 Based on the specific requirement and projected use of the building, conceptual coordinated detailed planning for the entire building will be finalized.



The electrical portion has to fit into such integrated concept of the building.

### **Co-ordination with Local Supply Authority**

The power requirement should be assessed, in consultation with the owner/ users, and discussion should be held with the Electricity supply authority to decide on location/ space required for Electricity supply equipment/ meter and tariff involved.

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#### **2.7 Following to be minimum requirement for electrification site**

Receiving power from State Electricity Board/GEB/Torrent	To receive power from SEB/GEB/Torrent power, as per the load requirement of site.  Location of Substation Transformer and 11Kv HT breaker, on each site in line with requirement of SEB/GEB/TORRENT.  Electrical load sheet to be submitted specifying the connected and demand loads. Sizing for the transformer to be done as per the same.  The output of transformer i.e. LT at 433V, 3-phase+Neutral, 50 Hz will be further distributed through FSP.
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Cabling for different voltage– 11kv and 415v	<p>LT Cable shall be 1.1KV, XLPE Armoured cable as per IS 7098 (P-1), 1988 and IEC rules.</p> <p>Laying of cable shall be Minimum 1200mm deep for 11kv, HT cable and 750mm deep for LT cable.</p>
Receiving power to Feeder Section Pillar (FSP)	<p>LT power (433Volts) to be received at Feeder Section Pillar.</p> <p>Underground cabling to be done with proper size chambers for cabling pulling. Spare cabling to be done as per the requirement of GEB or Torrent.</p>
Metering	<p>Power from FSP shall be received on Bus bar chambers to LT meters.</p> <p>Meters to be provided on hollow plinth and ground floor.</p> <p>Proper arrangement of all switchgears, meters to be done as per requirement of GEB/Torrent.</p>
LT Cabling and wiring for mains	<p>LT Cable to be sized for full load current and Voltage drop.</p> <p>From Transformer to FSP : 0.5%</p> <p>From FSP to Meter : 1.5 %</p> <p>From Meter to Unit (DB within house) : 1.5 %</p> <p>From DB to end point : 1.5 % (Total drop 5%)</p>
Wiring for mains	<p>Voltage drop shall be as per mentioned above.</p> <p>No wires less than 1.5 sq mm to be used. Cables if necessary shall also be used.</p>
Switches and Accessories	<p>Modular type switches and accessories to be installed from specified Make List.</p>
TV and Telephone systems	<p>Conduit provision will be provided for landline telephone system.</p> <p>1 No of PVC, MMS conduit of 20mm for each Pointof ELV system. Conduit provision will be done from ground floor</p>



	terminal box to each floor junction box.
Earthing and protection	Chemical Earthing with 3Mtr Deep GI pipe/ 600x600x6.3 mm GI PLATE earthing to be provided for Body earthing of panels, electrical devices, pump rooms, lifts etc.  Plate earthing to be provided for neutral earthing like Transformer and DG sets.

### **DIESEL GENERATOR SET**

#### **SCOPE OF WORK**

This specification covers the design, construction features, manufacture 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.

#### **CODES & STANDARDS**

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.

The DG set shall meet the requirements of the following standards and rules

Sr.	Item	Relevant IS
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
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

### TECHNICAL SPECIFICATIONS FOR DIESEL GENERATOR SET

Supplying and erecting, commissioning and testing diesel generating set having

1. continuous rating, 3 phase, 415 volts, 50 cycles A.C. supply comprising of a totally enclosed air/water cooled diesel engine with multi-cylinders developing suitable BHP not less than following capacity :

Continuous Rating KVA	BHP not less than
250	313

For other ratings R&B SOR shall be referred.

2. at 1500 RPM with 10% overload for one hour in 24 hours
3. with standard accessories like fly wheel, lubricating oil cooler, "A" class governor, heavy duty fuel wheel and lubricating oil filter, oil bath air filler, lubricating oil pressure gauge, end exhaust manifold, standard set of tools with adjustable spanners, screw drivers, feeder gauge, cylinder head to cover, joint cylinder head to exhaust, element lube oil filter,
4. 12/24 volts electric starting equipment complete with standard battery & Battery Charger, cut-outs, ammeter, necessary wiring, pressure gauge, starter etc and heavy duty Residential type exhaust silencer and vertical hot air duct both lagged with asbestos rope, save oil trays, exhaust piping of required length, standard fuel level indicator and piping
5. and drip proof alternator, self excited, self regulated, screen protected, with excitation system, capable of delivering the rated system output at 415 volts, 3 phase, 0.8 PF, 50 Hz, 4 wire, running at 1500 RPM, conforming to IS-4722- 1968 with voltage regulation +/- 5% of rated voltage from no load to full load.
6. Both the engine and alternator fitted on a common fabricated steel base plate with anti vibration mounting engine and alternator both connected to each other by flexible flange coupling



7. and with floor/wall mounted control panel box comprising of voltmeter ammeter, selector switches, ACB / MCCB / MCB of adequate capacity, indicator lamps duly wired with HRC fuses.
8. The alternator & control panel shall be connected with provided suitable capacity armoured cable
9. and complete with Acoustic enclosure (canopy) made out of 18 SWG CRCA Sheet, sound absorbing material Rockwool of 64 density & 100 mm thick conforming to IS:8183 The resin bonded rockwool covered from inside the canopy by perforated sheet with 3/4 mm holes, sound level not more than 75 dB at a distance of 1 mtr, as per CPCB norms.
10. Erection, commissioning and satisfactory testing as per requirement with first filling of fuel, oil, etc. **with guarantee of complete system for One year. & with obtaining all necessary certificate from Electrical Inspector.**

<b>DATA SHEET FOR D.G.SET</b>		
<b>Technical Specification</b>	<b>Unit</b>	<b>Details/Remarks</b>
<b>Design Philosophy</b>		<p>A.D.G. Set is meant to run emergency load.</p> <p>B.D.G SET should be suitable to cater the total load consisting of followings:</p> <ol style="list-style-type: none"> <li>1. One number of lift</li> <li>2. One number of Water pump</li> <li>3. Common lighting like passage, stair case, street light etc..</li> <li>4. 10% additional load of (1+2+3) above</li> </ol> <p>C. One number of D.G. Set shall be provided for 'actual' or 'imaginary' section of building.</p>
<b>General</b>		
Rating	KVA	As per detail specs
Rated Voltage	Volts	415
Rated Frequency	Hz.	50Hz
<b>Design Condition</b>		
Summer outdoor design temperature	Deg C	<b>50</b>
<b>DG SET</b>		
DG Set Make		As per Vendor List
Engine Make		As per Vendor List



Speed	RPM	1500 PRM
<b>Alternator</b>		
Make		As per Vendor List
Rating	KVA	As per detail specs
Voltage	Volts.	415V
Frequency	Hz.	50Hz
Phases		3
Power Factor		0.8lagging
Voltage Regulation	%	1 % From no load to full load at lagging power factor f 0.1 to 1.0
Over Load Capacity		10 % over load for 1 Hour after every 12 Hours.
Enclosures Protection		IP-23
No. of Poles / Speed		4 pole/1500 rpm
Embedded Temperature detector		As per standard.
Space Heaters		As per mfg. std.
Insulation		As per detail specs
<b>Control Panel</b>		
Metering equipment		Required
Indicating Instruments		Required
Local switch Gear (MCCB) for receiving DG		Required
Battery Charger		Required
Lub. Oil motor Start / Stop, if motor driven lub. Oil system		Required
Generator control panel with KW meter with demand indicator		Required
<b>AMF Panel</b>		
Automatic transfer switch BASED AMF Panel		Required
<b>Battery</b>		
Type		Maintenance Free
Voltage	V	12 V
Capacity at 10 hr. Rate	Ah	As per mfg standard
<b>Battery Charger</b>		
Type		SMPS or as per mfg. std.





<b>Acoustic Enclosure</b>		
Noise level	<u>db @ 1</u> <u>mtr</u>	As per latest CPCB norms
<b>Testing</b>		1. Required at manufacturer works. QAP to be got approved. 2. All commissioning checks at sites as per mfg norms.
<b>Tool kits</b>		Required
<b>Literature (Two sets each)</b>		
a) Operation & maintenance manual		Required
b) Parts catalog / list		Required

#### HANDING OVER DOCUMENTS

The supplier shall submit following:

1. GA drawing
2. Foundation layout
3. Rating and Diagram Plate
4. Data sheet indicating results of tests
5. Test reports
6. O & M manuals

#### METHOD OF MEASUREMENT

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.

#### TRANSPORT, DELIVERY & STORAGE

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 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 transit insurance. The charges for loading and unloading of equipments at site should form part of offer.

The transportation for any auxiliary item or detachable part of equipment should be simultaneous and carry necessary instructions for assembling and storage requirements.

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

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



## GUARANTEE & WARRENTY

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.

### TESTS:

#### FACTORY TEST

Complete tests at full load and 10% over load shall be carried out at the manufacture's works to determine the performance and operating characteristics of the assembled generating set and accessories to determine whether or not the guarantees have been met. Unless otherwise specified, all routine tests shall be carried out in accordance with the standards and shall be witnessed by the representatives of the purchaser. Manufacturer test certificate with manual in triplicate shall be supplied by the vendor.

#### SITE TEST:

After installation at site, the set should be tested for full load for eight hour.

Copies of all documents like routine and type test certificate of the equipment for the tests carried out at manufactures premises shall be furnished, as required.

#### OTHER APPLICABLE STANDARDS.

- (i) 3043/1987 - code of practice for earthing
- (ii) 4412/1981 -Specification for copper, wires for general engineering purpose.
- (iii) 5216/part I & part II /1982 guide for safety procedure and practice in electrical work.
- (iv) 2551/1982 - Danger notice boards

#### MAINTENANCE / SERVICE AFTER SALES:

##### DURING WARRANTY PERIOD.

The schedule for servicing of the DG set should be strictly adhered to after the installation of the D.G. set till the warranty period as per in schedule prescribed by the manufacturer.

#### ATTENDING BREAKDOWN / RECTIFICATION WORKS:

Any break down calls so received from the concerned Officers through FAX/ Telephonic message should be taken care of in arranging to attend them within Six hours from the time of receipt of such intimation.



The name of the servicing personnel available nearer to the installed site should be mentioned along with contact number for any emergency / exigency services. These personnel should be instructed accordingly.

### **LIFT**

Supplying, Erecting, Testing & Commissioning the Automatic passenger / stretcher lift having following main features:\

[1] GEAR LESS LIFT DRIVE comprising of High Starting torque Lift duty 3 phase 440 V A. C. Permanent magnetic synchronous motor of proper rating with high efficiency shall be used.

[2] Micro processor based / PLC, ACVVVF, vector control drive with encoder feedback closed loop system shall be used for lift car and door operation which shall be full collective selective operation hall call demand response, UP/DOWN hall stops, Main, Up/ Down Contactor with overload and phase reversal relay and safety controls.

[3] Car with M S platform with bracings of adequate size and to sustain the impact load cabin + passenger with safety factor of fire for steel and side panels of Stainless steel of sheet of grade 304 duty. Car ceiling will be S.S. finishes with aesthetic appearance with LED ceiling lights. Car flooring shall be of anti skid PVC with choice of colour of engineer in charge. Car doors shall be of stainless steel grade 304, hairline finish with centre opening / telescopic automatic doors. Car panel will also be S.S. 304 finished with emergency stop device, mechanical door safety device, facility of auto/ attended mode. All car panel buttons and all floor switches must be with brail language as per lift act.

[4] All landing doors shall be fully automatic centre opening/ telescopic opening made of hairline finish steel grade of 304 with key holes and infrared curtains with Unlocking facility from outside.

[5] Appropriate battery operated emergency light in the car along with alarm switch shall be provided.



[6] Digital scrolling indicator system for up-down arrow along with floor position indicator shall be provided inside the car and at all floors.

[7] Full height infra red curtain with multiple criss / crossing light beams shall be provided.

[8] Automatic Rescue Device (ARD) shall be provided accordingly of passenger capacity.

[9] Audio visual indication in the lift car showing over loading shall be provided such that doors kept open till excess load is removed.

[10] Spring buffers/PU Buffers shall be provided.

[11] Car fan with automatic sleep timer shall be provided.

[12] Voice annunciater with suitable music shall be provided in lift car.

[13] Self diagnostics system for operational and safety parameters shall be provided in control panel.

[14] Mechanical over speed governor, door key holes in the floor doors, fireman switch shall be provided.

[15] Lift machine hoisting arrangement in the lift machine room and monkey ladder for lift pit should be provided by the lift agency, along with the other steel structure works, foundations for the machine etc...

[16] In the hoist way fascia plate shall be provided without any extra cost, where ever required as / if directed by engineer in charge.

[17] Permanent wiring in lift machine room and lift well with proper numbers of light points, with fixtures, exhaust fan and plug points shall be provided by the agency. Power supply of 3 phase 440 V shall be made available by department in lift machine room.

[18] Any civil/ electrical works for additional and alteration in lift shaft and machine room related to erection of lift shall be made by lift agency without any extra cost.(granite/marble fixing around all landing door openings are not in lift agency's scope.)

[19] Agency has to provide all working drawings and documents and liaison services for obtaining all necessary permission from lift inspector and other authorities.

[20] As per statutory requirement of Got. Of Gujarat lift & escalator act 2000, lift agency has to provide

1. Car top safety barricade
2. Push & talk communication system.
3. Fireman's switch operation at Ground Floor

#### **1. ABOUT SPECIFICATIONS:**



1. This specification covers the requirement of design, manufacture, supply, erection, testing and commissioning of Passenger/Fire lift as specified.
2. 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.
3. Any material or accessory 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.
- 4.

## **2. CODES & STANDARDS:**

1. 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. Generally, the equipment should meet the requirements of the following standards and rules :
  - a) IS : 14566 – Electric Traction Lifts
  - b) Gujarat Lifts and escalator act (2001)
  - c) National Building Code 2005 with latest amendments.
  - d) Indian Electricity Acts and Rules.
2. In addition, other national/international rules and regulations as applicable to the equipments/work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

## **3. BRIEF SCOPE OF WORK**

- I. Supply, installation, testing and commissioning the elevator of required specifications
- II. To provide all necessary scaffolding
- III. Minor and Major civil works like creating holes in the walls, grouting of all bolts, fixing of steel members, indicators, button boxes etc.
- IV. Supplying, fabricating and installation of all kinds of steel works required installing and commissioning the elevators including machine rooms
- V. Providing and fixing necessary electrical works, wiring etc for elevators, hoist way and machine room.
- VI. Supply and erection of shaft reducer steel channels, if necessary.
- VII. All necessary approval from government authorities.
- VIII. All inclusive maintenance and breakdown service from the date of handing over.

## **4. DESIGN AND CONSTRUCTIONAL FEATURES:**

Supplying, Erecting, Testing & Commissioning the passenger/Fire lift having following main features:



- [1] GEAR LESS LIFT DRIVE comprising of High Starting torque Lift duty 3 phase 440 V A. C. Permanent magnetic synchronous motor of proper rating with high efficiency shall be used.
- [2] Micro processor based / PLC, ACVVVF, vector control drive with encoder feedback closed loop system shall be used for lift car and door operation which shall be full collective selective operation hall call demand response, UP/DOWN hall stops, Main, Up/ Down Contactor with overload and phase reversal relay and safety controls.
- [3] Car with M S platform with bracings of adequate size and to sustain the impact load cabin + passenger with safety factor of fire for steel and side panels of Stainless steel of sheet of grade 304 duty. Car ceiling will be S.S. finishes with aesthetic appearance with LED ceiling lights. Car flooring shall be of anti skid PVC with choice of colour of engineer in charge. Car doors shall be of stainless steel grade 304, hairline finish with centre opening / telescopic automatic doors. Car panel will also be S.S. 304 finished with emergency stop device, mechanical door safety device, facility of auto/ attended mode. All car panel buttons and all floor switches must be with brail language as per lift act.
- [4] All landing doors shall be fully automatic centre opening/ telescopic opening made of hairline finish steel grade of 304 with key holes and infrared curtains with Unlocking facility from outside.
- [5] Appropriate battery operated emergency light in the car along with alarm switch shall be provided.
- [6] Digital scrolling indicator system for up-down arrow along with floor position indicator shall be provided inside the car and at all floors.
- [7] Full height infra red curtain with multiple criss / crossing light beams shall be provided.
- [8] Automatic Rescue Device (ARD) shall be provided accordingly of passenger capacity.
- [9] Audio visual indication in the lift car showing over loading shall be provided such that doors kept open till excess load is removed.
- [10] As per statutory requirement of Got. Of Gujarat lift & escalator act 2000, lift agency has to provide
  - Car top safety barricade
  - Push & talk communication system.
  - Fireman's switch operation at Ground Floor

## 5. DETAILED SCOPE OF WORKS:

1. Design, manufacture, supply, erection, testing and commissioning of Passenger/Fire lift as specified.
2. **Schedule of Materials**



- 1 The contractor shall be responsible for unloading, storage, safe custody, accountability, testing etc.
- 2 The quantity for measurement will be actual and invisible loss; wastage etc shall not be paid or billed.
  - I) The contractor shall bear all incidental charges for the storage and safe custody of the materials at site at his own responsibility.
  - II) The contractor shall make arrangement at the site to protect from damage by rain, dampness, fire, theft etc.
  - III) In case any materials get damaged the contractor shall replace the same at his own cost.
  - IV) The contractor shall maintain a day-to-day account of the material supplied by Owner/Contractor in the prescribed Performa and it should be submitted along with RA bills.

**6. Clearance of site on completion.**

On completion of the works, the contractor shall clear away and remove from the site, all surplus materials, rubbish and temporary works of every kind and leave the whole site and works clean and in workman like condition to the satisfaction of Owner at his own cost. If the contractor fails to clear the site within 15 days after virtual completion/ submission of final bill whichever is earlier, it shall forfeit all his claims and the owner may get the site cleared at contractor's cost..

**7. Statuary Approval**

The contractor shall obtain necessary statutory approval from relevant government agency / lift inspector / electrical inspector. The statutory fees shall be paid by the contractor initially and same shall be reimbursed by SMC on submission of supporting document.

**8. Submission of the license or Commissioning certificate by TPI shall be treated as the final completion date , whichever is later.**

**9. Submission of the preliminary and final layout drawings and technical details**

The contractor shall submit the preliminary layout and technical details based on the Surat Municipal Corporation drawings for approval and shall submit the final layouts incorporating all comments. Execution will be allowed only after approval of the drawings. Prior approval from Surat Municipal Corporation shall be required for installation of each elements / accessories going to be installed inside CAR i.e. light fitting, floor mat, hand rail etc.

Drawing, Document to be submitted, in general:

- Outline dimensional drawing showing general arrangement, space requirements
- Bill of Materials.
- Typical installation plan.
- Technical leaflets on & complete specifications & OEM address for bought out items.
- QAP
- Any other details furnished by manufacturer

**10. Supervision**





The work shall have to be carried out in best workman like manner and supervised by competent erection engineers having adequate experience in the similar kind of work.

#### **11. Insurance & Indemnification**

The contractor shall take adequate insurance cover for his equipment, material, installation and personnel for transport and storage, till the completion of the project; and indemnify the Surat Municipal Corporation against any claims or liabilities that may arise due to any cause whatsoever. The indemnification shall cover, but not be limited to, accidents, injuries, loss, theft, etc. of items, properties and human beings.

#### **12. Free Maintenance**

The contractor shall provide free maintenance service for the period of 12 months from the date of handing over. Contractor shall supply the electrical cable, with necessary protective switch gears for the elevator as per requirement

Necessary Steel Channels for reduction of shaft (if required) shall also be in scope of the bidder. No extra payment shall be made for this to bidder.

#### **13. Testing and commissioning:**

**The installation, testing and commissioning of the equipment AT SITE shall be carried out in accordance with IS: 14665.**

**Quality Assurance Plan shall be got approved. The safety gear equipment and other parts as per approved QAP shall be tested as per relevant IS specifications AT THE MANUFACTURERS FACILITY in the presence of authorized representative of TPI and Surat Municipal Corporation, prior to dispatch for site.** All the expenses incurred for the same shall be borne by the contractor. At least 15 days prior notice should be given to TPI and Surat Municipal Corporation so as to enable them to depute a representative for the work. The above testing procedure does not relieve the contractor from his commitment/ contractual obligation / guarantee etc.

#### **14. Operation and maintenance manual:**

Operation and maintenance manual and drawings IN SOFT COPY AND HARD COPY (IN TRIPLICATE) shall be submitted.

#### **15 . Announcing System :**

Lift Announcing solid state system in the Passenger/ Stretcher lifts having AC2/ACVV/ACVF drives & automatic doors only. The system comprising following features & facilities.

- (i) Announcing floor message, message to close period
- (ii) Announcing 'Emergency Message' when lift is stuck between floors due to power failure or any other reason.
- (iii) Instrumental Music between floor announcing.



- (iv) Announcement in English / Hindi & Gujarati Languages..
- (v) Flexible to accommodate special pre-programmed message such as name of the building /office.
- (vi) Volume adjustment control

## **16. Overload Protection**

Providing & erecting approved make overload non-start feature & overload warning Indicator system in the lift with making use of sound isolated floating platform & micro switches on SI frame to get sensation of live load inside lift cage at any given moment, with provides new fixtures of overload warning inside lift cage with new relay in the existing control panel to activate 'Overload Non-Start Function' with carrying out additional wiring including laying of new travelling cable, include minor civil work & without changing the existing capacity speed stops, travel & operation of the desired lift

## **17. ARD (Automatic Rescue Device):**

Supplying and erecting approved make, solid stat inbuilt emergency rescue Device, for automatically rescues Passengers trapped in the lift car in between floors in the event of power failure having following features.

- (i) Automatic operation & immediate action in the event of mains failure capable to move the lift to the nearest landing, opens the automatic doors of the lift car & floor.
- (ii) Sealed, maintenance free battery back-up of suitable size with automatic charging unit & auto change over device on mains failure.
- (iii) RESCUE OPERA'TION' message indicator in the lift car
- (iv) Applicable to Passenger, Goods cum Passenger, Stretcher cum Passenger lifts with AC2, ACVV, ACVVVF drives & automatic doors.

## **19 GENERAL TERMS AND CONDITIONS:**

1. Tenderers are requested to submit necessary documents to prove their eligibility. Surat Municipal Corporation reserves right to accept or reject any offer without giving any reason.
2. Contractor shall furnish the test certificates for Machine, Motor, Motor Generator Set, Ropes, Safeties, Controller, selectors, Governors, Buffers, etc.
3. If there is any deviation, the bidder shall have to submit a deviation sheet along with technical bid only. If there shall not be any deviation sheet along with the technical bid, it shall be presume that bidder is agree with terms, conditions & specifications demanded by Surat Municipal Corporation.
4. Detail technical specifications of all parts of the elevators shall be submitted along with the technical bid of the tender.
5. Make and Manufacturer's name for all major items and parts shall be specified and submitted along with the tender.
6. Finished sizes of all members shall be as per the drawing and should fit with site conditions



wherever specified.

7. Unless otherwise specified, all metal surfaces shall be treated with zinc chromate primer.
8. The rates are inclusive of necessary scaffolding, tools and tackles, taxes, duties, levies, transportation etc. No other payment shall be made other than rates quoted in the price bid.
9. Electricity & water required for executing this work shall be in scope of contractor.
10. The rates shall be firm and not subject to exchange variations, labour conditions, fluctuations in railway freights or any conditions whatsoever. It shall also include for sales tax, VAT, excise duty, octroi and any other taxes/duty or other levy levied by the Central or State Governments or local authorities, sales tax on works contract if applicable. No claim in respect to the above mentioned shall be entertained by the Surat Municipal Corporation except the statutory taxes.

If there is an upward revision of statutory taxes, Corporation will reimburse the additional expenses on providing of necessary proof/receipts. Similarly, if there is a downward revision, Corporation will deduct the amount equivalent to the difference from the bills submitted for payment.

11. During defect liability period, if any fault occurs in the lift, the contractor shall have to attend the lift within 2 hours from intimation and clear the fault at earliest.
12. The corporation shall not be responsible to any accident/injury to the staff of the contractor during work. No compensation shall be paid in such incidences by SMC. The contractor is responsible for the safety of his staff members working at corporation's site.

**DATA SHEET FOR PROPOSED PASSENGER/FIRE LIFT**

<b>DUCT SIZE MUST BE</b>		<b>AS PER IS 14665</b>
<b>SR. NO</b>	<b>DESCRIPTION</b>	<b>As per Tender Specification</b>
A	Standard Applicable	IS 14665
B	Passengers/ Load	8 / 544 Kg, 10 / 680 Kg, 16 / 1088 Kg, 20 / 1360 Kg
C	Speed	1.0 mps up to 7 floors. 1.5 mtr above 7 floors.
D	Leveling Accuracy	+/- 10 mm to 15 mm
E	Entrance Position	All on one side
F	Power Supply	AC 400/440V, 3P/1P, 50 Hz
G	Operation/Control	Simplex / Duplex full collective with advanced microprocessor technology
H	Type	Passenger lift to be used.
I	Car Size	Suitable
J	Car Entrance	Min. 800 to 1000 mm (W) x Min.2000 mm (H). Exact



		dimensions to be decided during detailed engineering.
K	Car Operating Panel and Landing Operating Panel	Full Height SS with Square / Round buttons with all control buttons. Bidder may offer touch sensitive panel instead.
L	Car Door Operation	Fully Automatic with Center opening.
M	Car Wall	SS Hairline finish
N	Flooring	Anti skid Flooring/Granite Flooring to be decided during detailed engineering.
O	Car Door Protection	Multi-Beam Full Height Infra-Red Detector
P	Position indicators	To be provided at all floors
Q	Direction indicator on floor	To be provided at all floors
R	Lighting	LED Lighting
S	Type of Ventilation	To be suggested by supplier. To be decided during detailed engineering.
T	Other features	Alarm, Emergency Light, Overload Indicator, Telephone, ARD, Hand Rails

**SPECIAL NOTE:** Contractor has to refer & implement - Gujarat Lifts and escalator act (2001) , Chapter III -Lifts, Clause No 37 – Lift Cars, Sub Clause – 19 (a) (with latest amendments, if any), for provision of Fire Lift in case of building heights more than 24 Mtr.



## **30 KVA UPS (Uninterrupted Power Supply)**

### **Part 1 GENERAL**

#### **1.1. SUMMARY**

- A. This specification describes a three-phase, on-line, continuous operation, solid-state uninterruptible power supply (UPS) with the option to run in parallel with identical units. The UPS shall operate as an active power control system, working in conjunction with the building electrical system to provide power conditioning and on-line power protection for the critical loads.

#### **1.2. DESCRIPTION**

- A. The UPS shall consist of the following easy to repair modular rectifier/inverter sections and easy to install internal and external modular battery units.
- B. The UPS shall be provided with separate feeds for rectifier/inverter section and the static bypass switch.



- C. Modes of operation: The UPS shall operate as an on-line system in the following modes:
- i. *Normal*: The inverter and the rectifier shall operate in an on-line manner to continuously regulate the power to the critical load. The rectifier shall derive power from the AC input source and supply DC power to float charge the battery.
  - ii. *Battery*: Upon failure of the AC input source, the critical load shall continue being supplied by the main inverter without any switching. The inverter shall obtain its power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the AC input source.
  - iii. *Recharge*: Upon restoration of the AC input source, the UPS shall simultaneously recharge the battery and regulate the power to the critical load.
  - iv. *Static Bypass*: The static bypass switch shall be used for transferring the critical load to input supply without interruption. Automatic re-transfer to normal operation shall also be accomplished with no interruption in power to the critical load. The static bypass switch shall be fully rated and shall be capable of manual operation. The UPS shall be able to recharge the batteries while supplying full power to the load via the static bypass switch.
  - v. *Internal maintenance bypass switch*: The UPS shall be provided with an internal manual bypass switch for supplying the load directly from the mains supply, while the UPS is taken out for maintenance. The switch should be removable when the individual UPS unit has to run in parallel with other units.
  - vi. *External Maintenance Bypass Panel (MBP)*: The external Maintenance Bypass Panel shall be used for paralleling of multiple UPS units (optional for single UPS unit) to supply the load directly from the mains supply, if the UPS system has to undergo maintenance or service. An UPS input, output, common output and bypass breaker shall be housed in the same low-voltage assembly. The manual bypass breaker must be monitored by each UPS via an auxiliary contact. The Maintenance Bypass Panel must be housed in a wall mounted low-voltage assembly and painted in a black colour that complements the appearance of the UPS.
- D. The UPS shall be provided with RS-232 signalling and WEB/SNMP integration. This system must provide a means for logging and alarming of all monitored points plus email notification.
- E. The UPS shall have nominal voltage of 3×415/230V (adjustable for 3×380/220V, 3×430/240V), 50Hz, L1,L2,L3,N,PE.
- F. The UPS will be capable of paralleling up to max 4 like kVA and type UPS systems for capacity.



- G. The UPS shall be compatible with all types of data centres, data rooms and facilities. Dedicated service to one specific environment shall not be acceptable.

### 1.3. STANDARDS

A.	Directives for CE marking 73/237EEC	89/336/EDC
B.	Safety	EN/IEC62040-1-1
C.	Emissions	EN50091-2 / IEC62040-2
D.	Performance	EN/IEC62040-3
E.	Electro Static Discharge performance criteria A	EN/IEC 61000-4-2 level 3,
F.	Continuous Electromagnetic Susceptibility performance criteria A	EN/IEC 61000-4-3 level 2,
G.	Electrical Fast Transient Compatibility performance criteria A	EN/IEC 61000-4-4 level 2,
H.	AC Surge Susceptibility criteria	EN/IEC 61000-4-5 Level 3

### 1.4. CLASSIFICATION

- A. Classification according to EN/IEC 62040-3: VFI-SS-112

### 1.5. SUBMITTALS

- A. Proposal Submittals

- i. Bid system bill of materials
- ii. Product catalogue sheets or equipment brochures
- iii. Product guide specifications
- iv. System single-line operation diagram
- v. Floor layout
- vi. Capacity data
- vii. Piping connection drawing
- viii. Installation guide
- ix. Drawings for requested optional accessories

- B. Delivery Submittals

- i. Installation manual, which includes instructions for storage, handling, examination, preparation, installation, and start-up of all systems.
- ii. User manual, which includes operating instructions.
- iii. As built equipment drawings.

### 1.6. QUALIFICATIONS

- A. Manufacturer experience: The manufacturer shall have a minimum of 20 years experience in the design, manufacture, and testing of UPS and cooling systems.





- B. ISO 9001 Certification: The manufacturer shall be ISO 9001 & 14001 certified. Certification assures that the vendor's quality control & environmental measures have been certified by an accredited registrar and meet internationally recognized standards.

#### 1.7. ENVIRONMENTAL REQUIREMENTS

- A. Storage ambient temperature:  $-50^{\circ}\text{C}$  to  $40^{\circ}\text{C}$   
B. Operating ambient temperature:  $0^{\circ}\text{C}$  to  $40^{\circ}\text{C}$ .  $15^{\circ}\text{C}$  to  $25^{\circ}\text{C}$  is ideal for batteries (above the battery lifetime is reduced).  
C. Relative humidity: 0 to 95%, non-condensing.  
D. Storage elevation: 0 to 15000m.  
E. Operating altitude with no de-rating: 0 to 1000m feet above sea level.

## Part 2 PRODUCT

### 2.1. STATIC UPS

#### A. GENERAL

- i. The UPS shall be housed in a free standing enclosure. The enclosure shall be designed to blend into an IT environment. The cabinet shall be equipped for fork truck lifting. The UPS cabinet shall be painted with the manufacturer's standard colour, black. All service and installation access shall be from the front and top
- ii. The UPS should be able to line up and match and bolt together with other similar kVA and type UPS' to have the appearance of one entity.
- iii. The UPS shall be in a self contained cabinet and comprise 30kVA power section; Bypass Static Switch; Battery for standard run time and interface LCD display all mounted in a separate cabinet. The UPS shall permit user installable and removable battery units. The power section shall be of the Double Conversion On-Line topology with power factor corrected input.
1. The UPS shall be sized for 30 kVA and 24 kW load at power factor 0.8.
2. The UPS battery shall be sized for backup at a power factor of 0.7 for 30 minutes.
- iv. The UPS shall have a short circuit withstand capability of 30kA

#### B. SYSTEM INPUT

- i. Nominal Input voltage rating:  $3 \times 415/230\text{V}$  (adjustable for  $3 \times 380/220\text{V}$  or  $3 \times 430/240\text{V}$ )  
ii. Input Voltage range: 304-477V  
iii. Earthing principle: [TN-S] [TT] or [IT].  
iv. Input frequency: 40-70 Hz (auto sensing)  
v. Input power factor: 0.98  
vi. Magnetizing inrush current: NONE, if optional input isolating transformer is installed then 500% of nominal input current for less than one cycle  
vii. Input current distortion with no additional filters.  
viii.  $< 5\%$  THD at 100% load  
ix. Power walk-in/Soft-Start: Shall be linear from 0 to 100% of the load over a 15-second period



### C. SYSTEM OUTPUT

- i. Nominal Output voltage rating: 3×415/230V.
- ii. Earthing principle: [TN-S] [TT] or [IT].
- iii. Output voltage regulation for steady state and transient variations (at default parameter settings):
  1. ± 1% steady state for a static 100% balanced load.
  2. ± 1% steady state for a static 100% unbalanced load.
  3. ± 5% for a 0 to 100% load step.
- iv. Max. Voltage transient recovery time: 50 milliseconds to nominal.
- v. Output frequency regulation:
  1. Synchronized to mains over the range of 47-53Hz or 57-63Hz in normal operation
  2. 50 Hz ± 0.1 Hz in battery operation.
- vi. Output voltage harmonic distortion:
  1. <2% THD maximum and 1% single harmonic for a 100% linear load
  2. <5% THD maximum for a 100% non-linear load
- vii. Overload capability:
  1. 150% for 1 minute in normal operation
  2. 125% for 10 minutes in normal operation
  3. 110% continuous in bypass operation
  4. 800% for 500 milliseconds in bypass operation
- viii. Phase displacement:
  1. 20 degrees ± 1 degree for balanced load.
  2. 20 degrees ± 1 degree for 50% unbalanced load.
  3. 20 degrees ± 3 degrees for 100% unbalanced load.
- ix. Output Power Factor Rating: For loads exhibiting a power factor of 0.5 leading to 0.5 lagging, no de-rating of the UPS shall be required.
- x. Short circuit withstand: The UPS must withstand a bolted-fault short circuit on the output without damage to the UPS module.
- xi. System AC-to-AC efficiency >95.3% for loads greater than 100% of system load.
- xii. System AC-to-AC efficiency >94% for loads greater than 50% of system load.
- xiii. Acoustical noise: dB(A) of noise, typically, measured at 1 meter from the operator surface:
  1. < 58dBA - 30kVA

### D. COMPONENTS

#### i. Rectifier

1. Each UPS power module shall include an active power factor corrected, Insulated Gated Bipolar Transistor (IGBT) rectifier.
2. DC buss voltage shall be ±192Vdc nominal.
3. The battery charging shall keep the DC bus float voltage of ±220v, ±1%
4. The DC buss voltage shall be compensated against temperature variations (Battery Temperature Compensation) to always maintain optimal battery float charging voltage for temperature excursions above or below 25°C. Temperature compensation rate shall be 320mV/°C for ambient temperatures > 20°C and 0mV/°C for ambient temperatures < 20°C.
5. DC ripple voltage shall be less than ±1% of nominal with no battery connected.
6. Input power factor shall be 0.98 lagging at 100% load without the use of passive filters. Rectifier shall employ electronic waveform control technology to maintain the current sinusoidal.



7. Pulse Width Modulation (PWM) current control shall be used. Digital Signal Processors (DSP) shall be used for all monitoring and control tasks. Analogue control is not acceptable.
8. Reflected input current Total Harmonic Distortion (THD) shall not exceed 5% at 100% load.
9. Input voltage window: 304-477V.
10. Typical batteries recharge time per IEEE 485.

#### ii. Batteries

1. Standard battery technology shall be Valve Regulated Lead Acid (VRLA) Sealed Maintenance Free (SMF)
2. Batteries shall be housed in the Powdered Coated External rack.
3. Battery voltage shall be Battery Temperature Compensated as outlined in the rectifier section above.
4. End of discharge:  $\pm 160\text{Vdc}$ .
5. Battery Charge Current Limit: The UPS shall be capable of limiting the energy sourced from the mains for purposes of battery charging. As a default setting, the battery charge energy will be set to 100% of its nominal value. When signalled by a dry contact, (such as from an emergency generator) the UPS shall be capable of limiting the battery charge energy taken from the mains. This shall take place in user selectable increments of 75%, 50%, 25%, 10% and 0% of the nominal charge power. The selection shall be made from the UPS front panel display/control unit.
6. The battery charging circuit shall remain active when in Static Bypass and in Normal Operation.

#### iii. Inverter

1. The inverter shall consist of fast switching IGBT power module.
2. Inverter shall be PWM controlled using DSP logic. Analogue control shall not be acceptable.
3. The inverter modules shall be rated for an output power factor at 0.8.
4. Nominal output voltage shall be  $3 \times 415/230\text{V}$  and adjustable for  $3 \times 380/220\text{V}$  or  $3 \times 430/240\text{V}$ , 50Hz, L1,L2,L3,N,PE.
5. Efficiency of each module at full load: Not less than
  - 30kVA 94.5%
6. Output Voltage Total Harmonic Distortion at full load:
  - Less than 2% for 100% resistive load.
  - Less than 5% for computer load as defined by EN50091-3/IEC 62040-3.
7. Output voltage regulation
  - Static: Less than 1% at full linear load.
  - Dynamic: 5% at 100% step load.
8. Output frequency: 50Hz free running.
9. Crest factor: Unlimited but regulates it down to 2.7.
10. Remote Emergency Power Off (EPO) shall be standard (wall switch and wiring shall be provided by the electrical contractor).

#### iv. Static Bypass Switch

1. The static switch shall consist of fully rated Silicon Controlled Rectifiers (SCRs). Part rated SCRs with a wrap around contactor are not acceptable.
2. The static bypass switch shall automatically transfer the critical load to bypass input supply without interruption after the logic senses one of the following conditions:
  - Inverter overload beyond rating.



- Battery runtime expired and bypass available.
  - Inverter failure.
  - Fatal error in control system.
3. The static bypass switch shall automatically retransfer from bypass to the inverter, when one of the following conditions occurs:
- After an instantaneous overload-induced transfer has occurred and the load current has returned to less than 100% of the system rating.
  - The inverter is active (on).
4. The static bypass switch shall be equipped with a manual means of transferring the load to bypass and back to inverter.
5. If more than 10 transfers from and to inverter occur in a 10 minutes period, the load shall be locked on static bypass. An alarm communicating this condition shall be annunciated.

#### E. MECHANICAL

##### i. UPS

1. The UPS power section, Static Bypass Switch, internal manual bypass switch and the VRLA batteries shall be housed in a free standing enclosure in a matching black colour having the following specifications:
- Colour finish. Black
  - Dead front construction
  - Caster fitted for mobility. Levelling feet shall be supplied as standard.
  - The cable entry shall be from the bottom on the back of the UPS.
  - The UPS enclosure shall meet an ingress level of min. IP20.

#### F. 2.9 DISPLAY, CONTROLS AND ALARMS

- i.A microprocessor controlled display unit shall be located on the front of the system. The display shall consist of an alphanumeric display with backlight, an alarm LED, and a keypad consisting of pushbutton switches.

ii. The following metered data, shall be available on the alphanumeric display:

1. Year, Month, Day, Hour, Minute, Second of occurring events
2. Input AC Voltage
3. Output AC voltage
4. Output AC current
5. Input Frequency
6. Battery voltage
7. Highest Internal Battery temperature

- iii. The display unit shall allow the user to display an event log of all active alarms and of the 64 most recent status and alarm events.

The following minimum set of alarm conditions shall be available:

1. Static bypass switch on
2. EPO Active
3. Mechanical bypass activated
4. External bypass switch (Q3) activated
5. Battery discharged
6. Return from low battery
7. Low battery
8. Load not powered from UPS
9. UPS in bypass
10. Runtime calibration aborted
11. Runtime calibration started



12. Runtime calibration complete
  13. Battery self test aborted
  14. Battery self test started
  15. Battery self test completed
  16. Number of battery modules decreased
  17. Number of battery modules increased
  18. Fan fault
  19. SBS fault
  20. System not in sync.
  21. Bypass not available, frequency/voltage out of range
  22. Mains voltage/frequency out of range
  23. Site wiring fault
  24. Low battery voltage shut down
  25. EX R battery breaker or fuse open
  26. Defective battery detected
  27. Runtime is below alarm threshold
  28. Load is above alarm threshold
  29. Battery over-voltage warning
  30. Battery over-temperature warning
  31. Emergency power supply fault
  32. Output overloaded
- iv. The following controls or programming functions shall be accomplished by use of the display unit. Pushbutton membrane switches shall facilitate these operations.
1. Silence audible Alarm
  2. Set the alphanumeric display language
  3. Display or set the date and time
  4. Enable or disable the automatic restart feature
  5. Transfer critical load to and from static bypass
  6. Test battery condition on demand
  7. Set intervals for automatic battery tests
  8. Adjust set points for different alarms
  9. Program the parameters for remote shutdown.
- v. For purposes of remote communications with the UPS the following shall be available and contained within the UPS on a removable, “hot swappable” “smart slot” interface card:
1. RJ-45 Interface port for remote communications with a network via web browser or SNMP.
  2. Environmental monitoring feature, capable of locally monitoring temperature and humidity as well as one additional generic set of user determined dry contacts capable of taking an input signal from any Vendor or third party on/off signal, such as water detection, smoke detection, motion, or fire detection.
- G. BATTERY
- i. The UPS battery shall be of SMF type suitable for 30 minutes backup at 30 KVA load.

### **Part 3 ACCESSORIES**

#### **A. MAINTENANCE BYPASS PANEL (MBP)**



- i. A MBP should be offered as a standard option either for single module or multi module configurations. The maintenance bypass panel shall provide power to the critical load bus from the bypass source, during times where maintenance or service of the UPS system is required. The MBP shall provide a mechanical means of complete isolation of the UPS system from the mains supply. The MBP shall be constructed in a free-standing or wall-mounted IP20 enclosure unless otherwise stated in this specification.
- ii. As a minimum, the MBP shall contain the following features and accessories:
- iii. Current limiting breakers of the appropriate size – limiting the short circuit level to max.  $I_{cc} = 30 \text{ kA}$  for the system.
- iv. Minimum 1 NO/NC auxiliary contact per unit in the parallel system for the purpose of relaying status information of the manual maintenance bypass switch to the UPS.
- v. In the case of parallel operation sufficient Vendor CAN bus PCB's to provide adequate communications of the MBP status to the UPS system parallel control system.
- vi. CE marked according to at least EN/IEC60439.
- vii. The MBP shall be made to Form 3b
- viii. The MBP shall be made to IP2XC

#### B. PARALLEL OPERATION

- i. For purposes of paralleling UPS units in the event of increased capacity or redundancy, the UPS shall contain as a standard feature, the ability to parallel up to 4 modules. In this mode of operation the output voltage, output frequency, output phase angle, and output impedance of each module shall operate in uniformity to ensure correct load sharing. This control function shall not require any additional footprint and shall be an integral function of each UPS.
- ii. Multi-drop Bus Network: Communication between modules shall be connected in a multi-drop bus network comprising two parallel redundant busses so that the removal of any single cable shall not jeopardize the integrity of the parallel communication system.
- iii. Load Sharing: A load sharing circuit shall be incorporated into the parallel control circuits to ensure that under no load conditions, no circulating current exists between modules. This feature also allows each UPS to share equal amounts of the total critical load bus. Load sharing communications shall be galvanically isolated for purposes of fault tolerance between UPS modules. A UPS module's influence over load sharing shall be inhibited in any mode where the UPS inverter is not supporting its output bus.

#### A. SOFTWARE AND CONNECTIVITY

- i. The Ethernet Web/SNMP Adaptor shall allow one or more network management systems (NMS) to monitor and manage the UPS in TCP/IP network environments. The management information base (MIB) shall be provided in DOS and UNIX "tar" formats. The SNMP interface adaptor shall be connected to the UPS via the RS232 serial port on the standard communication interface board.
- ii. Unattended Shutdown
- iii. The UPS, in conjunction with a network interface card, shall be capable of gracefully shutting down one or more operating systems during when the UPS is on reserve mode.





- iv. The UPS shall also be capable of using an RS232 port to communicate by means of serial communications to gracefully shut down one or more operating systems during an on battery situation.

**B. REMOTE UPS MONITORING**

- i. The following three methods of remote UPS monitoring shall be available:
  - 1. Web Monitoring: Remote monitoring shall be available via a web browser such as Internet Explorer.
  - 2. RS232 Monitoring: Remote UPS monitoring shall be possible via either RS232 or contact closure signals from the UPS.
  - 3. Simple Network Management Protocol (SNMP): Remote UPS Monitoring shall be possible through a standard MIB II compliant platform.

**Part 4 EXECUTION**

**A. FACTORY ASSISTED START-UP**

If a factory assisted UPS start-up is requested, factory trained service personnel shall perform the following inspections, test procedures, and on-site training:

- i. Visual Inspection:
  - Inspect equipment for signs of damage.
  - Verify installation per manufacturer’s instructions.
  - Inspect cabinets for foreign objects.
  - Inspect Battery Units.
  - Inspect Power Module(s).
- ii. Mechanical Inspection:
  - Check all UPS and external maintenance bypass cabinet internal power wiring connections.
  - Check all UPS and external maintenance bypass cabinet terminal screws, nuts, and/or spade lugs for tightness.
- iii. Electrical Inspection:
  - Verify correct input and bypass voltage.
  - Verify correct phase rotation of all mains connections.
  - Verify correct UPS control wiring and terminations.
  - Verify voltage of all battery modules.
  - Verify neutral and ground conductors are properly landed.
  - Inspect external maintenance bypass switch for proper terminations and phasing.
- iv. Site Testing:
  - Ensure proper system start-up.
  - Verify proper firmware control functions.
  - Verify proper firmware bypass operation.
  - Verify proper maintenance bypass switch operation.
  - Verify system set points.
  - Verify proper inverter operation and regulation circuits.





- Simulate utility power failure.
- Verify proper charger operation.
- Document, sign, and date all test results.

v. On-Site Operational Training:

During the factory assisted start-up, operational training for site personnel shall include

- key pad operation
- LED indicators
- start-up and shutdown procedures
- Maintenance Bypass Panel operation
- Battery breaker operation
- Alarm information.

#### 4.2 MANUFACTURER FIELD SERVICE

- Worldwide service: The UPS manufacturer shall have a worldwide service organization available, consisting of factory trained field service personnel to perform start-up, preventative maintenance, and service of the UPS system and power equipment. The service organization shall offer 24 hours a day, 7 days a week, 365 days a year service support.
- Replacement parts: Parts shall be available through the worldwide service organization 24 hours a day, 7 days a week, and 365 days a year. The worldwide service organization shall be capable of shipping parts within 4 working hours or on the next available flight, so that the parts may be delivered to the customer site within 24 hours.

#### 4.3 MAINTENANCE CONTRACTS

- A complete offering of preventative and full service maintenance contracts for the UPS system and the battery system shall be available. All contract work shall be performed by Vendor's factory trained service personnel.

#### 4.4 TRAINING

- UPS service training workshop: A UPS service training workshop shall be available from the UPS manufacturer. The service training workshop shall include a combination of lecture and practical instruction with hands-on laboratory sessions. The service training workshop shall include instruction about safety procedures, UPS operational theory, sub-assembly identification and operation, system controls and adjustment, preventative maintenance, and troubleshooting.



### **Horizontal Open well Submersible Pump sets**

1. The job involves SETC of approved make portable Horizontal Open well Submersible Pump sets with its all accessories use in high rise building for water supply.
2. The pump should be 3 phase (415V, -15% & +6%), 50Hz, self priming and duty point of pump set shall be provided / shall be decided according to site situations.
3. Accessories: Submersible pump set complete with all accessories like portable stand, Cable size according to pump rating and cable length should be such that no joint is made inside the underground water tank. submersible copper cable without joint and 30 Mtr. Long or as required , enclosed with suitable pipe minimum 50 mm dia or next higher size recommend by the pump mfg. with special /fittings /clamps/base plate etc. shall be provided.
4. Material of construction shall be as below:
  - Pump impeller : Stainless Steel / Graded Cast Iron & Dynamically balanced.
  - Casing : High Grade cast iron.
  - Wear Rings : High quality abrasion resistance Bronze.
  - Shaft : Stainless Steel of adequate diameter to ensure rigidity and ground to close tolerances.
  - Cable Sealing Arrangement : Designed so that no bore well water with sand can enter the motor.
  - Motor Body : Cast Iron / Stainless Steel
  - Journal Bearings : Leaded Bronze and Stainless Steel, Water Lubricated, having high load bearing capacity.
  - Thrust Bearing : Carbon Vs Stainless steel and water lubricated to withstand high axial thrust loads.
  - Fasteners: - Stainless Steel
  - Portable Stand (Skirt Base) :- M.S. fabricated & epoxy coated



## EXTERNAL LIGHTNING PROTECTION SYSTEM AS PER INDIAN/INTERNATIONAL STANDARDS

### General

Lightning Protection System shall be in accordance with IEC 62305-3, IS:2309& IS 3043

### Zone of Protection

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.

### LPL (Lightning Protection Level)

LPL is a number associated with a set of lightning current parameters relevant to the probability that the associated minimum & maximum values do not exceed the normally occurring lightning. LPL can be determined by Risk analysis as explained in IEC 62305-2 .

LPL levels and probability of protection:

Lightning protection Class	Lightning current peak value MINIMUM	Lightning current peak value MAXIMUM	Interception probability
LPL 3:	10 kA	100 kA	88%

### 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
3	45	15*15	

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

Dissimilar metals (For e.g. copper with Aluminium) must be connected only by using bimetal 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 area	Remarks
Copper	Solid tape	50 sq mm	2mm min thickness
Copper	Solid round	50 sq mm	8mm dia
Aluminium	Solid tape	70 sq mm	3 mm min thickness
Aluminium	Solid round	50 sq mm	8 mm dia
GI	Solid tape	50 sq mm	3 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 at least 8mm diameter & 1.0 meter apart for vertical run.

Recommended distance between air terminal holders.

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 equipotential 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..

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)
3	15

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.

For earth termination system, 2 basic types of earth electrode arrangements are applicable. Type A & Type B arrangement.

Type A arrangement:

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. Type A arrangement is suitable in places where electronic equipments are not located.

Type B arrangement:

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.

In potentially corrosive areas, Stainless steel must always be used.

References:

IEC62305 – PROTECTION AGAINST LIGHTNING:

Part 1: General Principles

Part 2: Risk Management

Part 3: Protection of structures

Part 4: Protection of Electrical & Electronic equipments within structure

IS 2309: 1989: Code of practice -Protection of Buildings & allied structures against lightning.

IS3043: 1987 : Code of practice for earthing



## Octagonal street light pole

Supply, erection, testing and commissioning of octagonal pole (G.I)

### Design Considerations :

The Octagonal Poles shall be designed for followings:

- To withstand the maximum wind speed of 47m/sec.
- Maximum stress at wind speed of 47 m/sec shall not exceed 80% of the strength of steel.
- The detail of top loading i.e. the weight and area of top luminaries are worked out based on this consideration.
- Maximum deflection of the pole shall meet the requirement of BS 5649: part 6 1982.

### Constructional Features:

#### Pole:

- The pole shall be made from HR sheet and shall be hot dip galvanized as per IS 2629/IS 2633/IS 4759 standards with minimum coating thickness of 85 micron.
- The pole shaft shall have Octagonal cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding. The welding of pole shaft shall be done by Submerged Arc Welding process using state of the art know how.
- All Octagonal Pole shafts shall be provided with the rigid Flange plate of suitable thickness with provision for fixing four bolts. This base plate shall be fillet welded to pole shaft at two locations i.e. from inside and outside.

#### Embedded Termination Box:

#### Door (Termination Box):

- Door height should be 2000 mm above from the bottom of the Pole and door opening should be hinged type with necessary special locking bolt.
- An adequate door opening shall be provided at the base of the pole and the opening shall be such that it permits clear access to equipment like termination plate, MCB, cables, etc. The door opening shall be complete with a close fitting, vandal resistant, weather proof hinged type with mechanical internal lock with special paddle key.
- The door shall have required width-having height of minimum 500 mm at the elevation of 500 mm from the Base Plate. The door shall be vandal resistance and shall be dust proof to ensure safety of inside connections. The door shall be flush with exterior surface and shall have suitable locking arrangement.
- The door opening shall be carefully designed and reinforced welded steel section, so that undue buckling of the cut section under heavy wind conditions.

#### Terminal plate :





- Terminal plate made up of Bakelite with appropriate current rating, SP MCB (L Series) and stud type terminal shall be mounted at the base of the pole. If a particular light fitting has to be manually operated the same can be done by this MCB provided at the base compartment.
- The provided terminal shall be suitable for loop-in-loop-out of max. 4 Core x 25 sq mm armoured cable. 1 No. of SP 6 Amp MCB (L Series) per luminary shall be provided having rupturing capacity 9 kA.
- The cable shall be terminated at connector in the pole using ISI Marked XLPE 1.1 KV grade insulating tape roll with appropriate colour code. All items shall be fixed on the Bakelite sheet of suitable size having 12 mm thickness. There shall also be welded a clip of size 40 x 40 x 4 mm for the purpose of earthing.
- The pole shall be adequately strengthened at the location of the door to complete for the loss in section.
- Pole drawings (of manufacturer) must be got approved from concerned department.

#### **MATERIAL OF CONSTRUCTION:**

Octagonal Poles : Steel conforming to St 35 or required grade

Foundation Bolts : As per relevant IS

Base Plate : IS 226 / IS 2062 steel

The steel used to manufacture steel poles is as per BSEN 10025 grade S355 Jo. Yield strength Min. 355 N/mm<sup>2</sup> and Tensile strength 490 – 630 N/mm<sup>2</sup>.

Please note that among the various standards mentioned, most stringent will apply.

Indicative Dimensions for 5 mtr height pole:

HEIGHT (Min.) - 5 meter / 6 meter

O.D. TOP (Min.) - 70 mm

O.D. BOTTOM (Min.) - 135 mm

THICKNESS (Min.) - 3 mm

BASE PLATE (Min.) - 200 x 200 x 12 mm (PCD 200 mm)

Dimensions mentioned above are for generally used poles and indicative only. Illumination design (Which includes pole dimensions) shall be got approved.



## AVIATION LIGHT

It is an Omni-Directional Aircraft Warning light which conforms to ICAO, Annexure-14 type 'B'. LED Medium Intensity Aircraft Warning Lights are known for their supreme aesthetics and energy efficiency.

The high power high flux solid state Lights give an exceptionally long life of more than 50,000 burning hours.

It combines the most modern concept of surface mounting solid state Lights Technology (High powered Lighting Diodes) from most reputed world source.

The system is highly energy efficient, which makes it very suitable for Solar powered LED aviation lighting system.

The Lights are mounted on very Durable Epoxy masked PCB's which enables easy replacement in case of failure.

Efficient secondary optics is induced to generate Lens effect for proper light beam in horizontal plane and arrest unnecessary light dispersion in vertical plane as required by the lights specifications.

High quality Aviation Red color is directly emitted by the Aircraft Warning Light system thus eliminating the need for additional color filters, which otherwise get faded due to UV radiation of sun.

Efficient circuit designing reduces chances of total light blackout.

The Aircraft warning light housing is made from high grade Aluminum Alloy with protective painting.

Hardware is made from Corrosion resistant metals.

The light is protected from ingress of Dust and Moisture.

Bird Spike is provided at the top to protect the luminaries from bird droppings.

Very high quality copper conductor earthing connection is provided to divert any lightning surges.

Solid state Electronic Flasher is housed in separate weather protected enclosure.

Dusk to Dawn operation is enabled through Photo sensor or Electronic timer.

### Materials Used



Medium Intensity (LED) Obstruction lights are designed for stability with a high quality aluminium alloy with protective coating base. The dome is made of a Ultra Violet (UV) resistant acrylic and silicon sealant is used to ensure maximum life of the product. Best quality copper earthing connections are used for prompt and efficient lightening protection. All hardware cast in corrosion resistant metal alloys.

<b>Minimum Autonomy</b>	<b>24 hrs.</b>
<b>Latitude Range</b>	<b>1000 meter</b>
<b>On/Off Level</b>	<b>Automatic</b>
<b>Illumination Technology</b>	<b>Photons generation with LED conduction</b>
<b>Lifespan of LEDs</b>	<b>&gt; 1,00,000 hrs.</b>
<b>Available Flash Patterns</b>	<b>20 - 60 FPM</b>
<b>Color Technology of LED</b>	<b>Depend upon Semiconductor material of LED</b>

Excellent dust and moisture sealing through EPDM gaskets.

#### **Environmental and Electrical**

<b>Temperature Range</b>	<b>- 40 ° C to + 50 ° C</b>
<b>Waterproof</b>	<b>Through EPDM Gasket and Sealant</b>
<b>Environment Protection Standard for Light</b>	<b>IP 65 Standard</b>
<b>Environment Protection Standard for Control Panel</b>	<b>IP 55 Standard</b>



## **LED STREET LIGHT SPECIFICATIONS**

### **SUPPLY, ERECTION AND COMMISSIONING OF DETACHABLE BRACKETS: -**

**2 (g) Single arm 1.0 m**

**2 (h) Double arm 1.0 m**

**2 (i) Triple arm 1.0 m**

**2 (j) Single arm 1.5 m**

**2 (k) Double arm 1.5 m**

**2 (l) Triple arm 1.5 m**

Providing Street Light pole bracket consisting of medium class MS pipe of 4.2 cms. Outside dia 2.9 W.T complete with suitable sleeve tubing (If required) 45 cms. long M.S. pipe (Medium Class). Suitable for 76.5 mm /80mm / required size of pole top/ Wall mounting having sufficient fasteners for fixing the brackets and having spread as mentioned and having inclination up to 115 deg. with vertical plane & suitable welded stays, reducer and with check nuts complete painted with one coat of Red oxide / PU base primer and two coats of Aluminium / PU paint. paint with required nos of arms.

The bracket shall be hot dip galvanized as per IS 2629/IS 2633/IS 4759 standards.

### **SUPPLY, LAYING, TESTING AND CONNECTING UNARMoured CABLE:**

The item includes supply, laying, testing and commissioning of round 3 X 1.5 sq. mm for LED luminaries flexible unarmored single PVC insulated copper conductor cable 1100 V grade to be laid through the pole from luminaries to junction box by experienced technician without any damage. The cable joint shall not be allowed. Termination glands/lugs etc shall be included in the item.

### **SITC OF LED STREETLIGHT LUMINAIRE:-**

### **TECHNICAL SPECIFICATION FOR ENERGY EFFICIENT LED BASED LUMINAIRE UNIT FOR STREETLIGHT: -**



This specification is for technical and general requirements design, development, manufacturing, testing and supply of energy efficient LED luminary for street light complete with all accessories, LED lamps with suitable current control driver circuit and required optics including mounting arrangement.

#### **CODES & STANDARDS: -**

IEC 60529 Classification of degree of protections provided by enclosures (IP Codes)  
EN 55015, CISPR15 Limits and methods of measurement of radio disturbance characteristic of electrical lighting and similar equipment.  
IEC 62031 LED modules for general lighting-Safety requirements  
IEC 61547-EMC Immunity requirement  
IEC 60598-2-1 Fixed general purpose luminaries  
IEC 60598-1 Luminaries - General requirement and tests  
IEC 61000-3-2 Electro Magnetic compatibility (EMC)- Limits for Harmonic current emission -- (equipment input current 16 A per phase.  
IEC 60068-2-38 Environmental Testing: Test Z- AD: composite temperature/ humidity cyclic test  
IEC 61347-2-13 Lamp control gear: particular requirements for DC or AC supplied electronic control gear for LED modules.  
IS 10322 Specification for the luminaries  
IS 4905 Method for random sampling  
LM 79 LED luminary photometry measurement.  
LM 80 Lumen Maintenance  
IEC 62384 DC or AC supplied electronic control gear for LED modules performance requirements  
IEC/ PAS 62612 Self-ballasted LED lamps for general lighting services- Performance requirements

#### **ENVIRONMENTAL CONDITIONS: -**

The LED streetlight is to be used in city of Surat. It is located in Southern part of Gujarat. It is well connected with rails & roads, situated on Mumbai Ahmedabad Railway and nearby road is NH # 8. The average atmospheric condition during the year is mentioned below. The equipment shall be designed to work in such environmental conditions:

- (i) Maximum ambient air temperature: **50° C**
- (ii) Minimum ambient air temperature: **10° C**
- (iii) Max. Relative humidity: **90%**
- (iv) Average Rainfall: **55 inches**
- (v) Atmosphere: **Dusty and Heavy chemical smoke at times in certain areas.**
- (vi) Coastal area: The equipment shall be designed to work in coastal area in humid, salt laden and corrosive atmosphere.



## CONSTRUCTIONAL FEATURES:

### General:

- a) Luminaries shall be made of die cast aluminium/ extruded Aluminium body with powder coated finish having safety.
- b) Heat sink used should be aluminium extrusion having high conductivity. Heat sink should be integrated within luminaries and efforts shall be made to keep the overall outer dimensions
- c) optimum such that it permits sufficient heat dissipation through the body itself so as to prevent abnormal temperature inside the luminaries and consequential damage to cover, gasket material, LEDs, lenses and drivers.
- d) LED must be mounted on Metal core PCB with suitable large area surface by means of fins to dissipate the conduct heat. The fins must be exposed to ambient flowing air.
- e) All luminaries shall be provided with toughened glass of min. 0.8 mm thickness of sufficient strength. UV stabilized Poly carbonate material is also acceptable. High efficiency prismatic diffuser/Lens under the LED chamber to protect the LED and luminaries shall be provided.
- f) The minimum IK protection of optic cover shall be IK 05. The test material certificate shall be provided.
- g) Suitable number of LED lamps shall be used in the luminaries. The manufacturer shall submit the proof of procurement of LEDs from OEMs at the time of testing.
- h) Suitable reflector/ lenses may also be provided to increase the illumination uniformity and distribution.
- i) The electrical component of the LED and LED driver must be suitably enclosed in sealed unit to function in environment conditions mentioned earlier.
- j) The connecting wires used inside the luminaries, shall be low smoke halogen free, fire retardant e-beam cable and fuse protection shall be provided in input side.
- k) Design of the thermal management shall be done in such a way that it shall not affect the properties of the diffuser.
- l) The equipment should be compliant to IEC 60598-1, IEC 62031 and IEC/PAS 62612 depending on the type of luminary.
- m) The LED Module(s), Driver gear, etc. shall be designed in such a way so that temperature of heat sink shall not exceed 70° C.
- n) All the material used in the luminaries shall be halogen free and fire retardant confirming to standard.
- o) The infrastructure for Quality Assurance facilities to verify/ test/ prove above specifications must be available at the manufacturing facility. The compliance shall be indicated clearly in the tender itself.
- p) All fasteners must be of stainless steel.
- q) All glands inside/ outside luminaries must be metallic
- r) Heat sink must be thermally connected to MCPCB/ LED light source.

### **High power and high lumen efficient LEDs suitable for following features shall be used:**

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- a) The working life of the lamp at junction temperature of 85° C (max) at operating current shall be more than 50,000 working hours of accumulative operation and shall be suitable for continuous operation of 24 hours per day. These features shall be supported with datasheet.
- b) Adequate heat sink with proper thermal management shall be provided.
- c) Lumen maintenance report as per LM 80 guidelines shall be produced for the power LEDs used.
- d) Thermal management shall be in such a way that LED soldering point temperature shall not go beyond 75° C.
- e) The LED luminaries shall be free of glare.

**LED DRIVER specification used for streetlight:**

- a) Current waveform should meet relevant nation and international standard.
- b) LED Driver shall withstand, withstand voltage up to level mentioned elsewhere in tender and restore once normal working when normal voltage is applied.
- c) The life of the driver should more than 25000 Hrs.
- d) Maximum Temperature rise  $\leq 30^{\circ} \text{C}$  @  $45^{\circ} \text{C}$   $T_{\text{amb}}$ . With safety margin of  $10^{\circ} \text{C}$ .
- e) The control gear should be compliant to IEC 61347-2-13, IEC 62031 and IEC 62384 as per the requirements.
- f) The driver of the luminaries should have Short Circuit, Over Voltage, over current, over temperature, Under Voltage, String Open protections.
- g)

**The electronic components used shall be as follows:-**

- a) The protective cum adhesive coating used on PCBs should be cleared and transparent and should not affect colour code of electronic components or the product code of the company.
- b) The construction of PCBs and the assembly for components for PCBs should be as per IS standards.

**Illumination Level:**

The luminaries shall be so designed that the illumination level shall be evenly distributed and shall be free from glare. The lux distribution curve/ graph/ spatial distribution shall be submitted.

**DATA SHEET: LUMINAIRE**



Sr. No.	Parameter	Data/ Details of LED luminary	
(1)	Rated Input Power of LED luminary (max.) Watts	20	45
(2)	Width of the road	3-6 m	6-12 m
(3)	Average spacing	25 m	22 m
(4)	Initial Output of System (including all losses) Lumen (min.)	2000	3500
(5)	Tilt Angle (wrt to horizontal surface)	0° to 15°	0° to 15°
(6)	Min. Uniformity Ratio ( $E_{min}/ E_{avg}$ )	0.3	0.3
(7)	Min Transverse Uniformity Ratio ( $E_{min}/ E_{max}$ )	--	0.2
(8)	Correlated Colour Temperature	5500° K $\pm$ 500° K (ANSI Binning)	
(9)	Colour Rendering Index (min.)	> 65	> 65
(10)	Illumination Regulation	<5% (w. r. t $T_a$ & Line Voltage)	<5% (wrt $T_a$ & Line Voltage)

#### GENERAL DATA SHEET

Sr. No.	Parameter	Value/Detail
•	Rated Supply Voltage	230 V ~, 50 Hz
•	Input supply voltage range	120-270 V
•	Expected Input Frequency	50 Hz +/- 3%
•	Working Temperature	+5° to +50° C
•	Working Humidity	10% - 90% RH
•	Usage hours	Dusk to dawn
•	Power Factor	0.90
•	Index of Protection Level	IP 66 as per IEC 60529.
•	Surge Protection	4 KV
•	LED Chip efficacy	120 lm/ W
•	Driver Efficiency	> 85%
•	Junction Temperature of LED	< 85° C
•	Rated Life @ L70	50,000 burning hours at 35° C ambient temperature
•	Nominal Correlated Colour Temperature	5000° K to 6000° K
•	Dispersion Angle	Minimum 120°



•	Tilting angle	Adjustable
•	Maintenance factor of luminaire	0.85
•	Colour Rendering Index	65
•	Total Harmonic Distortion	< 10 % (EMI/ EMC Certification)
•	LED MAKE	Cree/ Osram/ Nichia/ Philips Lumileds

### **Particulars and Details to be submitted by the bidder:**

In order to properly assess and due diligence on submissions, the Bidder should provide following information on the quality and photometric of proposed luminaries.

#### **1. General Description**

Following details of the proposed luminary shall be submitted as per Annexure: II.

#### **2. Electrical specifications**

Electrical ratings of the proposed luminary product shall be submitted in Annexure: III.

#### **3. LED chip and driver information**

LED chip and driver information of the proposed luminary product shall be submitted in Annexure: IV.

#### **4. Photometric information to be submitted as per Annexure: V.**

#### **5. TESTS & CERTIFICATES:**

Tests are classified as:-

Type test

Acceptance test

Routine test.

The luminaries' should be tested as per IEC 60598-2-3: 2002 standards and following test reports should be submitted: -

- (i) Heat Resistance Test
- (ii) Thermal In SITU Test
- (iii) Ingress Protection Test
- (iv) Drop Test
- (v) Electrical/ Insulation Resistance Test,
- (vi) Endurance Test,
- (vii) Humidity Test,



- (viii) Electrical and Photometric Measurements Test Report (IES LM 79)
- (ix) LED Lumen Maintenance Test Report (IES LM 80)
- (x) Vibration test as per ANSI

**Type Test: -**

Type test certificates for both the luminaries' shall be provided with the technical-bid.

**Acceptance Tests: -**

These tests are carried out by an inspecting authority at the supplier's premises on sample taken from a lot for the purpose of acceptance of a lot. Acceptance tests shall not be carried out from particular size from the lot on which type tests have already been conducted. Recommended sampling plan is given below.

**Sample size and criteria for conformity**

The luminaries shall be selected from the lot at random. In order to ensure randomness of selection, procedures given in IS 4905-1968 (Reaffirmed 2001) may be followed.

**Routine Tests:**

These tests shall be performed by the manufacturer on each complete unit of the same type and the results shall be submitted to the inspecting agency, prior to offering the lot for acceptance test. The firm shall maintain the records with traceability.

**Test Scheme & Quality Assurance: -**

Sr. No.	Description of test	Prototype Test	Type Test	Acceptance Test	Routine Test
1	Visual and Dimensional check	Y	Y	Y	Y
2	Checking of documents of purchase of LED	Y	Y	Y	Y
3	Resistance to humidity	Y	Y	---	---
4	Insulation resistance test	Y	Y	Y	Y
5	HV test	Y	Y	Y	Y
6	Over voltage protection	Y	Y	Y	---
7	Surge protection	Y	Y	Y	---
8	Reverse polarity	Y	Y	Y	Y
9	Temperature rise Test	Y	Y	---	---
10	Ra (Colour Rendering Index) measurement test	Y	Y	---	---
11	Lux measurement	Y	Y	Y	Y
12	Fire retardant Test	Y	Y	---	---
13	Test for IP 65 protection	Y	Y	Y	---
14	Environmental tests	Y	---	---	---
15	Reliability Test	Y	---	---	---
16	Life Test	Y	Y	---	---
17	Endurance Test	Y	---	---	---
**	<b>Quality Assurance</b>				
18	Testing at	Approved govt. lab	Approved govt. lab	manufacturer works	manufacturer works
19	Testing by	---	---	SMC/TPI	SMC/TPI
20	Test frequency	---	As per Manufacturer	Lot wise.	Lot wise.
21	Lot size Not less than	---	---	1000 Nos. Of luminaries	40 Nos. Of luminaries'
22	Test Sample Size	---	---	1 no Min.	Min.10%.
23	Documentation to be submitted	Whenever asked	With technical bid	During testing at Manufacturer works	During testing at Manufacturer works



24	LM 79 and LM 80 test report & result	----	Must to be submitted with technical bid	----	----
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**Method of Testing: -**

**Visual and Dimensional Check:**

The unit shall be checked visually for all dimensions as per approved design and drawing.

General workmanship should be good; all the components properly secured and sharp edges shall be rounded off. Check the marking and quality of the workmanship visually. Check the rating and make of electronic/ electrical items.

**Checking of documents of purchase of LED**

Check Document of purchase of LED lamps of approved sources viz. NICHIA/ OSRAM/ PHILIPS LUMILEDS/ CREE.

**Resistance to humidity test**

This is carried out by suspending the painted panels in corrosion chamber maintained at 100% RH and temperature cycle of 42 to 48° C for 7 days and examining it for any sign of deterioration and corrosion of metal surface.

**Insulation resistance test**

The insulation resistance of the unit between earth and current carrying parts shorted together shall not be less than 2 M when measured with 500 V megger.

**HV test**

Immediately after insulation resistance test, an AC voltage of 1.72 KV rms (1500 + 2 x rated voltage) of sine wave form of 50 Hz shall be applied for one minute between the live parts and frame. There shall not be any kind of break down, flashover or tripping of supply.

**Over voltage protection**

The LED Driver Shall be cut off once voltage exceeds 288 V AC. It shall be reconnected when supply comes within limit.

**Surge protection**

It shall withstand a surge of 4 KV at the input terminals for all types.

**Reverse polarity**



The Luminaries' shall withstand polarity reversal. It shall be operated with reverse voltage for Min. 1 minute at maximum value of voltage range. At the end of this period, the supply shall be made correct polarity and Luminary shall operate in a normal way.

#### **Temperature rise Test:**

Temperature rise Test shall be conducted at 100 V ~ with full load. The temperature rise shall be recorded by temperature detectors mounted at the specified reference points on the body of semiconductors, capacitors and other components as agreed between purchaser and manufacturer. The maximum-recorded temperature under worst conditions shall be corrected to 55° C and compared with maximum permissible temperature (for power devices at junction). Under loading conditions as specified above, the corrected temperature of the power devices shall have a safety margin of minimum 10° C.

Temperature at junction shall not exceed 100° C when corrected to 55° C. The Luminaries' shall also be subjected for short time rating after continuous loading to ensure the temperature rise is within the permissible limit. The maximum temperature rise of the electronics devices on the PCBs shall be in limit for industrial grade components suitable for 85° C environment. In case of exceeding limit, use of MIL-grade component shall be considered keeping RDSO informed.

#### **Ra (Colour Rendering Index) measurement test**

The lumen is the unit of luminous flux, which is equal to the flux emitted in a solid angle of one steradian by a uniform point source of one candela.

The initial reading of the chromaticity co-ordinates x & y shall be within 5 SDCM (Standards Deviation for Colour matching) from the standardized rated value as per Annex: D of IEC 60081- 1997.

The initial reading of the general colour-rendering index (Ra) shall not be less than the rated value decreased by 3.

The lumen maintenance of the lamp shall not be less than 80% of the initial lumen after 20,000 burning hours and 70% of the initial lumen after 50,000 hours. The initial lumen will be taken after 100 hours aging.

Photometric test shall be conducted as per Annexure: B of IEC 60081-97.

The lumen maintenance test shall be done as per Annexure: C of IEC 60081-97.

#### **Fire retardant Test**

Fire Retardant test shall be conducted as per IEC 60332-1 of the wire used in the luminaries.

#### **Test for IP 65 protection**

This test shall be conducted as per IEC 60529.

#### **Environmental tests (Prototype Test)**



The Luminary shall meet the following tests as prescribed in IEC–60571.

- (i) Dry heat test.
- (ii) Damp heat test
- (iii) Test in corrosive atmosphere
- (iv) Combined dust, humidity and heat test

#### **Reliability Test**

The reliability can only be determined in actual service. However, the following tests shall be carried out on the prototype to simulate as close as possible, the service conditions.

There shall be no failure during this test.

- (i) The light unit shall be mounted in an oven maintained at 45° C.
- (ii) The light will be operated at the specified maximum voltage and at 45° C for a period of 100 hours.

#### **Photometry Test: -**

**The test shall be carried out for Total Luminous Flux, Luminous Intensity Distribution, Electrical Power, Luminous Efficacy (calculation), Color Characteristics– Chromaticity, CCT & CRI etc. as per IES LM 79.**

#### **Life Test**

**The lumen maintenance & life test shall be done as per IES LM 80 for LEDs.**

#### **Endurance Test**

The Luminaries shall be kept “ON” with input voltage of 250 V ~ for 200 hours. After this the Luminaries is subjected to 20,000 cycles of “ON” and “OFF”, each cycle consisting of 3 seconds “ON” and 10 seconds “OFF” period. Luminaries should survive this test. Test is to be continued for 20,000 cycles, followed by performance test.

#### **Safety:**

The Luminaries shall comply with the safety requirements as per IEC 61195.

**All Tests defined for acceptance other than LM 79 and LM 80 are allowed to carry out at Manufacturer works.**

## **6. INFRINGEMENT OF PATENT RIGHTS**

Surat Municipal Corporation shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of the components, used in design, development and manufacturing of these light luminaries and any other factor which may cause such dispute. The responsibility to settle any issue rises with the manufacturer.





7. **MARKING:**

The following information shall be distinctly and indelibly marked on the housing:

- Year of manufacture/ Batch Number/ Serial Number
- Name of Manufacturer (Engraving only, stickers not allowed)
- Rated watt and voltage
- Input frequency



## INSPECTION AND TESTING

### AT MANUFACTURER'S WORKS :

Inspection & testing shall be carried out in the presence of SMC / TPI person of all electrical and fire system related equipment, however contractor should have to submit company/ manufacturer test certificate for the same.

Each major component of the electrical and fire system related equipment shall be subjected to shop tests by the respective manufacturer and corresponding test reports/certificates shall be furnished by him along with supply document of equipments.

- Electrical and Fire system related equipment:

Each assembled equipment shall be shop tested by the manufacturer in presence of TPI/SMC's representative to determine the following characteristics within the operating range as specified.

- All Test Report
- Data Sheet
- Efficiency curve
- Total power consumed
- Motor-Pump set tested at works of pump manufacturer with VFD at 25Hz for 01hour.

All the test shall be conducted in accordance with the relevant IS / manufacturers testing standards and shall be witnessed by the end user at manufacturers works. Each equipment performance shall be documented by obtaining concurrent reading showing all electrical and mechanical parameters, and it should be match with its data sheet and must be followed the IS standards. Such reading shall be documented for at least 5 no of same equipment.

### POST INSTALLATION/PRE COMMISSIONING CHECKS:

All Electrical and Fire system related equipment shall be commissioned only after due pre-commissioning checks after installation. **For this, authorized and qualified representative of manufacturer shall oversee and confirm the workmanship of equipment installation. All pre commissioning checks, as enlisted in equipment manual, shall be witnessed by manufacturer's representative.**



**First time starting of the equipment (after pre commissioning checks) shall be carried out only after satisfactory installation certificate/acceptance by manufacturer representative. In any case, contractor shall not be allowed to commission the equipment without confirmation of installation and satisfactory pre commissioning checks by manufacturer representative.**

POSTCOMMISSIONING/FIELD TESTING :

After installation equipment offered will be subjected to testing in field for its satisfactory & trouble free working for maximum test working hours. If the field performance is found not to meet the requirement, then the equipment shall be rectified and / or replaced by the vendor.

### **IS Code & Act for Electrical Work**

All Specification, standard, publication etc. specified mean the latest standards, publication etc. pertaining to Electrical Installation and should conform to the following wherever applicable.

- 1) Indian Electricity Act 1910 with its amendments.
- 2) Indian Electricity Rules 1956 and its amendments.
- 3) Indian Electricity supply Act, 1948.
- 4) Regulation for Electrical Equipment in building by I.E.F. London.
- 5) The Factory Act 1948 and its amendments.
- 6) I.S.-732-1982 Part-I, II & III code of practice for Electrical wiring and fittings in buildings for low and medium voltages.
- 7) I.S. 4064-1967 H.D. Air break switches and fuses for Voltages not exceeding 1100 volts.
- 8) I.S. 3043 – Earthing code of practice for
- 9) I.S. - 1554 Part-I - 1970 PVC insulated (Heavy duty) Electrical Cables for working voltages up to and including 1100 volts.
- 10) IS : 694 - 1964 Part-II - PVC insulated cable with Aluminum conduits (revised) for voltages up to 1100 volts.



- 11) IS : 5908-1970 - Electrical installations in buildings, method of measurements of.
- 12) IS : 4237-1967 - General requirement for switchgear and control gear for voltage not exceeding 1000 volts.
- 13) IS : 1653-1964 - Rigid steel conduits for electrical wiring (revised).
- 14) IS : 2509-1973 - Rigid steel conduits for electrical installation. (First revision).
- 15) IS : 1258-1967 - Bayonet landholders (First revision)
- 16) IS : 418-1957 - Tungsten-Filament General service electric lamps (Third revision)
- 17) IS : 374-1966 - Fans and Regulators, ceiling type, electric (Second revision)
- 18) IS : 2667-1964 - Fittings for rigid steel conduits for electrical wiring.
- 19) IS : 3419-1976 - Fittings for rigid non-metallic conduits (First revision)  
National Electric Code, 1986



## SPECIAL CONDITION

- (1) Point wiring shall be from the distribution box or fuse board, No sub main shall be measured.
- (2) Samples of materials shall be given to Engineer-in-charge and approval should be taken in writing before its use.
- (3) Fabrication drawing should be get approved from the Engineer-in -charge prior to Manufacturer.
- (4) Pipe laying lay out shall be as per consultants drawings.
- (5) There shall be no junction in wiring out let box shall be used after bond.
- (6) Electrical contractor shall make good the civil work if chased of damaged.
- (7) Electrical Engineer-in-charge opinion shall be final and binding on contractor.
- (8) Qualified labor and supervisors shall work at site.
- (9) Electrical Contractor shall not permit unqualified labor contractor to work at site. He shall observe Govt. rules regarding control of labor. He shall submit test report and carry our tests as required and furnish detailed drawings on completion of work. The responsible authorized person by the contractor should be available of site daily when work is in progress.
- (10) The work shall be carried out during working days between 8.00 A.M. to 6.00 P.M. only. The cable trench should not remain open for more than 24 hours after excavation. If contractor intends to work on holiday or outside working hours specified, he shall take prior permission from the Engineer-in-charge. In that case overtime to the staff shall have to be paid by the Contractor. The Electrical appliance-materials shall be bear the ISI mark or declaration indicating manufacture's names and appliances material used having been manufactured in accordance with the manufactures' certificate issued by the Government of Gujarat and confirming to the standard specified by the I.S.I. shall be given by the contractor.
- (11) Cost of all test should be bare by contractor/ Tenderer, carried out for Electrical and Fire System related equipment in presence of TPI/PMC/SMC's representative.

The conditions laid down under House Hold Electrical appliances (Quality control Act 1981) shall be followed.

I/We agree to carry out the above work at rates indicated above at \_\_\_\_\_ percentage above/below the rates indicated above i.e. I/We agree to carryout the above work at a total cost of Rs. \_\_\_\_\_ .

The Contractor shall provide test report and get the installation approved from Govt. Elect. Authority is required.

CONTRACTORS STAMP AND SIGNATURE.

GENERAL MANAGER (IT)  
SURAT SMART CITY DEVELOPMENT LIMITED

