



The Bhagirathi Co-op. Milk Producers' Union Ltd.

(A Govt. of West Bengal Project)

Feeder Dairy: P.O-Berhampore: PIN -742101: Dist.-Murshidabad

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NOTICE INVITING E-TENDER

BU/PUR/ENGG/1166

Dated: 25/10/2025

The Bhagirathi Cooperative Milk Producers' Union Limited invites Online Tender (E-Tender) in two bid system for Supply, Installation and Commissioning of Electrical Distribution System & Modification of Power Distributes line at Hariharpara BMC Unit.

IMPORTANT DATE AND TIME SCHEDULE

Sl. No.	Particulars	Date & Time
1	Date of uploading (Publishing) of N.I.T. Documents (Online)	25.10.2025 at 1600 hrs
2	Documents download start date (Online)	25.10.2025 at 1605 hrs
3	Technical Bid proposal submission start date (Online)	25.10.2025 at 1610 hrs
4	Bid Submission end date (Online)	10.11.2025 at 1600 hrs
5	Technical bid opening date	12.11.2025 at 1600 hrs
6	Pre bid Meeting & Site Inspection	25.10.2025 from 1000 hrs
7	Financial Bid Opening date	To be notified later

The details of work are given below:

Nature of Work	Detailed in NIT
Scope of Work	Detailed in NIT
Estimated Cost of Work	Rate to be offered by the bidder as per prevailing market rate.
Statutory & Non Statutory Documents	1. GST Registration Certificate 2. Copy of valid PAN Card 3. Certificate of State Govt. Licensed Electrical Supervisor Cum Contractors 4. Company Trade License 5. Experience Certificate of similar such job 6. ITR File of last 3 years N.B: All these documents are mandatory. Failure to upload the documents will result in disqualification during technical bid. No document is to be sent physically.
Earnest Money Deposit	The EMD amounting to Rs. 10,000/- should be deposited online through Net Banking, NEFT/RTGS in favour of The Bhagirathi Cooperative Milk Producers' Union Limited payable at Berhampore. EMD shall not carry interest. Tenderers will select the Tender to bid and initiate payment of pre-defined EMD for that tender by selecting from either of the following payments modes (vide Finance Department Memorandum no. 3975-F(Y) Dt. 28/07/2016) : 1. Net banking (any of the banks listed in the ICICI Bank Payment gateway) in case of payment through ICICI Bank Payment Gateway. 2. RTGS/NEFT in case of offline payment through bank accounts in any Bank.

Payment procedure

a) Payment by Net Banking (any listed bank) through ICICI Bank Payment Gateway :

1. On selection of net banking as the payment mode, the bidder will be directed to ICICI Bank Payment Gateway webpage (along with a string containing a Unique ID) where he will select the Bank through which he wants to do the transaction.
2. Bidder will make the payment after entering his Unique ID and password of the bank to process the transaction.
3. Bidder will receive a confirmation message regarding success/failure of the transaction.
 1. If the transaction is successful, the amount paid by the bidder will get credited in the respective Pooling account of The Bhagirathi Cooperative Milk Producers' Union Limited maintained with the Focal Point Branch of ICICI Bank at R.N. Mukherjee Road, Kolkata for collection of EMD/Tender Fees.
 2. For transaction failure, the bidder will again try for payment by going back to the first step.

b) Payment through RTGS/NEFT:

1. On selection of RTGS/NEFT as the payment mode, the e-Procurement portal will show a pre-filled challan having the details to process RTGS/NEFT transaction.
2. The bidder will print the challan and use the pre-filled information to make RTGS/NEFT payment using his Bank account.
3. Once payment is made, the bidder will come back to the e-Procurement portal after expiry of a reasonable time to enable the NEFT/RTGS process to complete, in order to verify the payment made and continue the bidding process.
4. If verification is successful, the fund will get credited to the respective Pooling account of The Bhagirathi Cooperative Milk Producers' Union Limited maintained with the Focal Point Branch of ICICI Bank at R.N. Mukherjee Road for collection of EMD/Tender Fees.
3. Hereafter, the bidder will go to e-Procurement portal for submission of his bid.
4. But if the payment verification is unsuccessful, the amount will be returned to the bidder's account.

B. Refund/Settlement Process:

- i. After opening of the bids and technical evaluation of the same by the Quotation inviting authority through electronic processing in the e-Procurement portal of the State Government, the Quotation inviting authority will declare the status of the bids as successful or unsuccessful which will be made available, along with the details of the unsuccessful bidders, to ICICI Bank by the e-Procurement portal through web services.
- ii. On receipt of the information from the e-Procurement portal, the Bank will refund, through an automated process, the EMD of the bidders disqualified at the technical evaluation to the respective bidders' bank accounts from which they made the payment transaction. Such refund will take place within T+2 Bank Working Days where T will mean the date on which information on rejection of bid is uploaded to the e-Procurement

	portal by the Tender inviting authority. iii. Once the financial bid evaluation is electronically processed in the e-Procurement portal, EMD of the technically qualified bidders other than that of the L1 will be refunded, through an automated process, to the respective bidders' bank accounts from which they made the payment transaction. Such refund will take place within T+2 Bank Working Days where T will mean the date on which information on rejection of financial bid is uploaded to the e-Procurement portal by the Quotation inviting authority. iv. If the L1 bidder accepts the LOI and the same is processed electronically in the e-Procurement portal and the information on Award of Contract (AOC) to the L1 bidder is uploaded to the e-Procurement portal by the tender inviting authority. v. As soon as the L1 bidder is awarded the contract (AOC) and the same is processed electronically in the e-Procurement portal – a) EMD of the L1 bidder for tenders of State Government offices will automatically get transferred from the pooling account to the State Government deposit head “8443-00-103-001-07” through GRIPS along with the bank particulars of the L1 bidder. b) EMD of the L1 bidder for tenders of the State PSUs/Autonomous Bodies/Local Bodies/PRIs, etc will automatically get transferred from the pooling account to their respective linked bank accounts along with the bank particulars of the L1 bidder. In both the above cases, such transfer will take place within T+1 Bank Working Days where T will mean the date on which the Award of Contract (AOC) is issued. vi. The Bank will share the details of the GRN No. generated on successful entry in GRIPS with the E-Procurement portal for updation. vii. Once the EMD of the L1 bidder is transferred in the manner mentioned above, Tender fees, if any, deposited by the bidders will be transferred electronically from the pooling account to the Government revenue receipt head “0070-60-800-013-27” through GRIPS for Government tenders and to the respective linked bank accounts for State PSU/Autonomous Body/Local Body/PRIs, etc tenders. viii. All refunds will be made mandatorily to the Bank A/c from which the payment of EMD (if any) were initiated.
Bid Document	The bid document is available in the E-Tendering Portal of Govt. of West Bengal https://wbtenders.gov.in .
Technical Bid Evaluation	The Technical Bid will be evaluated by the Tender Committee. Bidders shall upload all the necessary documents in the Technical Folder which will be verified and evaluated by the Tender Committee.
Financial Bid	Rate shall be quoted in the Financial bid The bidder shall quote the rate online through Computer only in the space marked for quoting rate in the Bill of Quantities (BOQ). Only downloaded copies of the above documents, digitally signed by the bidder are to be uploaded (Excel file). The rate quoted by the tenderer shall be inclusive of all elements of taxes and duties, demands, tolls etc. The tenderer shall include income tax, GST etc as applicable, octroi if any and all other charges if applicable while quoting the rate, FOR (freight on road) delivery of the material in the place of delivery.
Validity of Bid	90 days
Award of Contract	The bidder/bidders shall be selected after item-wise evaluation

	(Financial Evaluation shall be done separately) of financial bid by the tender committee will be given Award of Contract, subject to fulfillment of Terms and Conditions provided in the tender.
Publication of Tender	1. E-Procurement Portal Govt. of West Bengal (https://wbtenders.gov.in) 2. Website of the Milk Union (www.bhagirathimilk.com) 3. Office Notice Board

TECHNICAL SPECIFICATIONS

Particulars	Quantity
SCOPE OF WORK OF ELECTRICAL MODIFICATION AND REWIRING OF HARIHARPARA BMC CAPACITY ENHANCEMENT. 1. DISMANTLING OF EXISTING WIRINGS CABLE SWITCHBOARDS PANELS ETC. 2. WIRING IN RIGID PVC CONDUIT (ISI MARK) OF LIGHT POINTS WITH FRLS SINGLE CORE 1.0 SQ MM COPPER WIRE IN SURFACE WITH PVC(ISI) BOXES AND MODULAR SWITCH. 3. SAME AS ABOVE BUT 6A PLUG POINTS WITH 1.5 SQ MM IN SEPARATE SWITCH BOARD WITH 3 RD PIN EARTHED AS PER IS 3043 4. SAME AS ABOVE BUT 16A PLUG POINTS WITH 4 SQ MM IN SEPARATE SWITCH BOARD WITH 3 RD PIN EARTHED AS PER IS 3043. 5. SAME AS ABOVE BUT 6A PLUG POINTS IN THE SAME SWITCH BOARD OF LIGHTING. 6. CONNECTION OF MOTORS WITH 3X4 SQ MM COPPER ARMoured CABLE. 7. SUPPLY AND INSTALLATION OF 1 NO 4 WAY TPN DB WITH ALL MCBS AND INCOMING 4 POLE MCB FOR POWER CIRCUITS LIKE MOTORS, PUMPS, GEYSERS OR OTHER HEAVY DUTY LOAD 8. SAME AS ABOVE BUT 6WAY FOR LIGHTING AND COMPUTER LOAD. 9. CONNECTING THE EXISTING INVERTER WITH LIGHTING DB FOR EMERGENCY OPERATION. 10. FABRICATION AND INSTALLATION OF CUBICLE TYPE SURFACE/FLOOR MOUNTED PANEL BOARD WITH DEGREE OF PROTECTION IP 55 HAVING MADE OF 2MM CRCA SHEET. a) 200A COPPER BUSBAR b) 125A TM 4 POLE MCCB. c) 3 OUTGOINGS FOR 3 NOS OF SERVO VOLTAGE STABILIZER TO BE SUPPLIED BY OTHER AGENCY. 63 A 4 POLE MCCB. d) THE PANEL SHOULD HAVE LIGHTNING PROTECTION DEVICE e) THE PANEL SHOULD HAVE UNDER VOLTAGE AND OVER VOLTAGE PROTECTION. f) THE PANEL SHOULD INCORPORATE DEVICE FOR REGULATION OF VOLTAGE FLUCTUATION. g) THE PANEL SHOULD HAVE AUTOMATIC START AND STOP OF GENERATORS IN CASE OF UNREGULATED VOLTAGE AND POWER CUT WITH MANUAL OVERRIDE.THE SHOULD BE A PROVISION FOR REMOTE OPERATION AND MONITORING. h) 2 NOS 32A 4 POLE MCCB FOR 2 NO TPN D.B. i) 1 NO 63A 4 POLE MCCB FOR SPARE. j) 2 NO DP 32A MCB FOR OTHER CONNECTION EARTHING CHEMICAL EARTHING WITH 3 MTR / 2 MTR COPPER ANNEALED 40 M DIA G.I PIPE AND CHEMICAL FILLING WITH FIBRE GLASS EARTH PILOT CHAMBER. WITH 25X6 MM G.I FLAT CONNECTION FROM ELECTRODE TO TERMINATION POINT. a) 2 NOS FOR GENSET BODY AS PER IS 3043. (2 MTR LONG PIPE) b) 2 NOS FOR GENSET NEUTRAL AS PER IS 3043 c) 2 NOS FOR LIGHTNING PROTECTION. d) 2 NOS FOR PANEL BOARD AND INTERNAL WIRING. (2 MTR LONG PIPE)	1 Job

Technical Specification for supply & works				
1. MAKE OR BRAND OF ELECTRICAL MODIFICATION AND REWIRING OF HARIHARPARA BMC CAPACITY ENHANCEMENT. THE BRAND CHOICE IS THE DISCRETIONARY POWER OF THE CLIENT (BHAGIRATHI CO-OP MILK..) 1. PVC PIPE, BOXES MAKE ANCHOR/PRECISION/ISI MAKE 2. MODULAR SWITCHES MAKE LEGRAND /ANCHOR/ISI MARK 3. COPPER WIRE AND CABLE FRLS MAKE RR KABELS/PHENOLEX/POLYCAB 4. MCCB, SPD, MCB, UNDER, OVER VOLTAGE MAKE L&K/SIEMENS/LEGRAND 5. EARTHING MATERIALS ISI MAKE AND CERRTICATES SHOULD BE PRODUCED. 6. OTHER MATERIALS REPUTED OR ISI MAKE.				
2. ISI standards as per Tabulation				
Sl. No.	Standard	Title	Reaffirm Year	Amdt
(1)	IS 732:2019	Code of practice for electrical wiring installations (fourth revision)	2019	
(2)	IS 4648:1968(R2017)	Guide for electrical layout in residential buildings	2012 (R2017)	
(3)	IS8061:1976(R2016)	Code of practice for design, installation and maintenance of service lines upto and including 650 V	2011 (R2016)	
(4)	IS8884:1978(R2002)	Code of practice for the installation of electric bells and call systems	2012 (R2002)	
(5)	IS5578:1984/ IEC 60391(1972)	Guide for marking of insulated conductors (first revision)	2011	
(6)	IS11353:1985/IEC 60445 (1973)	Guide for uniform system of marking and identification of conductors and apparatus terminals	2017	
(7)	IS13234:1991/IEC 60909: 1988	Guide for short circuit current calculations in three-phase ac systems (superseding IS5728)	2017	
(8)	IS7752 (Part 1): 1975	Guide for improvement of power factor in consumer installation:Part1Low and medium supply voltages	2016	
(9)	IS3646 (Part 1): 1992	Code of practice for interior illumination: Part 1 General requirements and recommendations for working interiors (first revision)	2018	
(10)	IS3646 (Part 2): 1966	Code of practice for interior illumination: Part 2 Schedule of illumination and Glare index	2018	
(11)	IS3646 (Part 3): 1968	Code of practice for interior illumination: Part 3 Calculation of coefficients of utilization by the BZ method	2018	
(12)	IS 4347:1967	Code of practice for Hospital Lighting	2020	
(13)	IS 6665:1972	Code of practice for industrial lighting	2020	
(14)	IS 2672:1966	Code of practice for library lighting	2020	
(15)	IS 10118 (Part1):1982	Code of practice for selection, installation and maintenance of switch gear and control gear : Part 1 General	2018	
(16)	IS 10118 (Part2):1982	Code of practice for selection, installation and maintenance of Switch gear and control gear: Part 2 Selection	2016	
(17)	IS 10118 (Part3):1982	Code of practice for selection, installation and maintenance of switch gear and control gear : Part 3 Installation	2016	
(18)	IS 10118 (Part4):1982	Code of practice for selection, installation and maintenance of switch gear and control gear : Part 4 Maintenance	2016	
(19)	IS 4146:1983	Application guide for voltage transformers (first revision)	2016	
(20)	IS 4201:1983	Application guide for current transformers (first revision)	2016	
(21)	IS 5547:1983	Application guide for capacitor voltage transformers (first revision)	2016	
(22)	IS 2309:1989	Code of practice for protection of buildings and allied structures against lightning (second revision)	2010	1
(23)	IS 3043:1987	Code of practice for earthing (Second Revision)	2018	2

(24)	IS5216 (Part1):1982	Recommendations on safety procedures and practices in electrical work: Part 1 General	2020	
(25)	IS5216 (Part2):1982	Recommendations on safety procedures and practices in electrical work: Part 2 Life saving techniques	2020	
ELECTRIC FANS CODES OF PRACTICEGUIDE				
Sl. No.	Standard	Title	Reaffirm Year	Amdt.
(1)	IS 555:1979	Electric table type fans regulators	2020	2
(2)	IS 1169:1967	Electric pedestal type fans and regulators	2019	6
(3)	IS 374:1979	Electric ceiling type fans (fourth revision)	2019	6
(4)	IS 2997:1964	Air circulator type electric fans and regulators	2019	8
(5)	IEC:60665(1981) IS 2312:1967	Propeller type ac ventilating fans	2010	8
(6)	IS 3588:1987	Electric axial flow fans	2009	1
(7)	IS 3963:1987	Roof Extractor units	2009	3
(8)	IS 4283:1981	Hot Air Fans	2009	3
(9)	IS 6272:1987	Industrial Cooling Fans(man Coolers)	2009	2
(10)	IS4894:1987	Centrifugal Fans	2009	3
(12)	IS 12155:1987	General and safety Requirements for Fans and Regulators for Household and similar purposes	1999	
LOW VOLTAGE SWITCH GEAR AND CONTROL GEAR CODES OF PRACTICE GUIDE				
Sl. No.	Standard	Title	Reaffirm Date	Amdt.
1)	IS 4237:1982	General requirements for switchgear and control gear for voltages not exceeding 1000 volts ac or 1200 volts dc		
2)	IS6875(Part 1):1973	Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages up to and including 1000Vac & 1200 Vdc:Part1General requirements [superseded by IS 13947 (Part5/Section1)]	1992	
3)	IS6875(Part 2): 1973	Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages up to and including 1000 Vac and 1200Vdc:Part2 Push- buttons and related control switches [Superseded by IS13947 (Part5 / Section1)]	1992	
4)	IS6875(Part 3): 1980	Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages up to and including1000Vacand1200Vdc: Part 3 Rotary control switches [superseded by IS 13947 (Part 5/ Section 1)]	1992	
5)	IS 10027:2000	Composite units of Air-Break switches and Rewireable Type Fuses for voltages Not Exceeding 650volt ac-Specification (Second revision)	2018	
6)	IS4064(Part 1): 1978	Air-break switches, air break disconnectors, air-break switch disconnectors and fuse- combination units for voltages not exceeding 1000 V ac or 1200 V dc: Part 1 General requirements (revised) [superseded by IS13947(Part3):1993]		
7)	IS 2675:1983	Enclosed Distribution Fuse Boards and Cut Outs for voltages Not Exceeding 1000 V A.C.or1200VD.C.	2016	
8)	IS 8828:1996	Electrical Accessories Circuit-breakers for over current protection for household and similar installations (second revision)	2006	
9)	IS 13032:1991	AC Miniature Circuit Breaker Boards for voltage Not Exceeding 1000 Volt	2016	1
10)	IS 12640 (Part1):2008	Residual Current operated Circuit Breaker without integral over current Protection for Household and similar uses (RCCBs) Part1 General Rules (Second Revision)	2016	
11)	IS12640(Part2): 2008	Residual Current Operated Circuit-Breakers with integral over current Protection for Household and similar Uses Part 2 General Rules (Second Revision)	2016	
12)	IS 2959:1985	Contactors for voltages not exceeding1000 V ac or 1200 V dc		

13)	IS 12021:1987	Control transformers for switch gear for voltages not exceeding 1000 Volt AC specifications (first Revision)	2015	2
14)	IS 5039:1983	Distribution pillars for voltages not exceeding 1000 volts AC and 1200 VDC	2021	2
15)	IS 8623(Part1): 1993/ IEC 60439-1 (1985)	Low voltage Switchgear and control gear assemblies:Part1Requirements for type-tested and partially type tested assemblies. (Suspended IS/IEC 61439-2:2011)	2013	0
16)	IS8623(Part 2):1993/ IEC60439-2(1987)	Low voltage switch gear and control gear assemblies :Part2 Particular requirements for Busbar trunking systems (Busway)	2018	1
17)	IS8544(Part 1): 1977	Motor starters for voltages not exceeding 1000 V: Part Direction line ac starters [superseded by IS 13947 (Part4/Section1):1993]		2
18)	IS8544(Part 2): 1977	Motor starters for voltages not exceeding 1000 V : Part2 Star-delta starters [supersededbyIS13947(Part4/Section1): 1993]		
19)	IS8544(Part3/Sec 1): 1979	Motor starters for voltages not exceeding 1000 V : Part 3 Rheostaticmotorstarters,Section1Generalrequirements [superseded by IS 13947(Part 4/Section1):1993]		
20)	IS8544(Part 4): 1979	Motor starters for voltages not exceeding 1000V: Part4 Reduced voltage ac starters: two step auto-transformer starters [supersededbyIS13947(Part4/Section1):1993]		
POWER CABLE CODES OF PRACTICE GUIDE				
Sl. No.	Standard	Title	Reaffirm Date	Amdt.
1)	IS694:1990/ IEC60227- 1 to 5(1979)	PVC Insulated cables for working voltages up to and including 1100 V	2010	0
2)	IS694:2010	Polyvinyl chloride insulated sheathed and unsheathed cables with rigid and flexible conductor for rated voltages upto and including : Part1Generalrequirements(fourth revision)	2020	
3)	IS1554(Part1): 1988/ IEC60502(1983)	PVC insulated (heavy duty) electric cables: Part For working voltages including 110 V	2020	5
4)	IS3961(Part 1): 1967	Recommended current ratings for cables: Part1 Paper insulated lead sheathed cables	2016	
5)	IS 4288:1988	PVC insulated (heavy duty) electric cables with solid aluminium conductors for voltages upto and including 1100V (second revision)(withdrawn)		
6)	IS4289(Part1): 1984/ IEC60245-5	Flexible cables for lifts and other flexible connections: Part 1 Elastomer insulated cables(first revision)		
ELECTRIC WIRING ACCESSORIES				
Sl. No.	Standard	Title	Reaffirm Date	Amdt.
1)	IS9537(Part1): 1980/ IEC60614-1(1978)	Conduits for electrical installations:Part1 General Requirements	2020	(1)
2)	IS9537(Part 2): 1981documents23 and 23A (Central Office) 29 Draft	Conduits for electrical installations:Part2 Rigid steel conduits (superseding IS:1653)	2017	(2)
3)	IS 3480:1966 B.S.731 :Part-I: 1952 UL1-1957	Flexible steel conduits for electrical wiring	2017	(1)
4)	IS 3837:1976	Accessories for rigid steel conduits for electrical wiring (first revision)	2017	(1)
5)	IS9537(Part 4):1983 Documents 23A (Central Office) 23	Conduits for electrical installations:Part4 Pliable self-recovering conduits of insulating materials	2017	

	and23A (Central Office)			
6)	IS 3419:1988 BS4607(Part-1): 1984	Fittings for rigid non-metallic conduits (Second Revision)	2017	
7)	IS 2412:1975	Specification for Link clips for electrical wiring First Revision	2017	(2)
8)	IS 371:1999	Ceiling roses– Specification Third Revision	2020	(4)
9)	IS4160:2005/IEC 60884-2-6 (1997)	Interlocking switch socket outlets– Specification	2020	
10)	IS1293:2019/ IEC 60884-1 (2002)	Plugs and Socket-Outlets for Household and Similar Purposes of Rated Voltage up to and Including 250 V and Rated Current upto and Including 16 A — Specification (Fourth Revision)	2010	(1)
11)	IS B371:1999	Ceiling roses Specification	2020	
12)	IS4160:2005 IEC Publication 60884-2-6(1997)	Interlocking switch socket outlets– Specification First Revision		
13)	IS4649: 1968	Specification for adaptors for flexible steel conduits		
14)	IS9537(Part3): 1983 IECPublication614- 2 (1980)	Specification for conduits for electrical installations Part3 rigid plain conduits of insulating materials		
15)	IS9537(Part8): 2003 IEC Publication 60614-2-7(1995) 2018	Conduits for electrical installation – Specification Part8 rigid non-Threadbare conduits of aluminum alloy		
16)	IS10276(Part1) :1982 a) b) c) Electro technical Commission 238 (1975) Edison screw lamp holders. IECP	Specification for Edison screw lamp holders Part 1 requirements and tests		
17)	IS10276(Part2) :1982 IECPublication61 (1969)	Specification for Edison screw lamp holders Part 2 standard data sheets for lamp holders and gauges		
18)	IS14763:2022	Conduit Systems for Cable Management Outside Diameters of Conduits for Electrical Installations and Threads for Conduits and Fitting		
19)	IS14768(Part2) :2003 IEC Publication 61035-24(1993)	Conduit fittings for electrical installations- Specification Part 2 metal conduit fittings		
20)	IS14927(Part1): 2001 ISO 9226	Cabletrunkingandductingsystemsfor electricalinstallationsPart1general requirements		
21)	IS14927(Part2): 2001	Cable Trunking and Ducting Systems for ElectricalInstallationsPart2CableTrunking and Ducting Systems Intended for Mounting on Wallsor Ceiling		
22)	IS14930(Part7): 2001	Conduit Systems for Electrical Installations- Part 2 Particular Requirements - Conduit Systems Burred Underground		
23)	IS15368:2003 EEC61242(1995)	Cable reels for household and similar purposes		
24)	IS15787:2008 IEC Publication 60884-2-3	Switch-Socket-Outlets Non-Interlock Type		

25)	IS16205(Part1): 2017 ice61386-1	Conduit systems for cable management Part I general requirements		
26)	IS16205(Part21): 2017	Conduit Systems for Cable Management Part 21 Particular Requirements Rigid Conduit Systems		
27)	IS16205(Part22): 2017	Conduit Systems for Cable Management Part 22 Particular Requirements-Pilable Conduit Systems		
28)	IS16205(Part23): 2017	Conduit Systems for Cable Management Part 23 Particular Requirements Flexible Conduit Systems		
29)	IS16205(Part24): 2017	Conduit Systems for Cable Management part 24 Particular Requirements Conduit Systems Buried Under Ground		
30)	IS16783:2018	Cable Cleats for Electrical Installations		
31)	IS17039:2018IEC 61316:1999 IEC 61316:1999	Industrial Cable Reels		
32)	IS17345(Part1): 2020 LEC61534-1	Power Track System Part1 General Requirement		
33)	IS17345(Part21): 2020 IEC61534-21	Power Track System Part 21 Particular Requirements for Power Track Systems Intended for Walland Ceiling Mounting		
34)	IS/TEC60309-1:2002 IEC60309-1(1999) IEC60309-1(1999)	Plugs socket-Outlets and couplers for industrial purposes Part 1 general requirements First Revision		
35)	IS/TEC60320-2-2): 1998 IEC60320-2-2:1998	Appliance couplers for household and similar general purposes Part 2 Sec 2 interconnection couplers for household and similar equipment		
36)	IS/IEC60320-2-3): 1998 IEC60320-2-3:1998	Appliance couplers for household and similar general purposes Part2-3appliance couplers with a degree of protection higher than ipxo		
37)	IS/IEC60669-2-2): 2006 IEC60669-2-2:2008	Switches for Household and Similar Fixed Electrical Installations Part 2 Particular Requirements Section 2 Electromagnetic remote-control switches <u>RCS</u>		
38)	IS/IEC60669-2-1): 2008 60669-2-1	Switches for Household and Similar Fixed Electrical Installations Part 2 Particular Requirements Section 1 Electronic Switches		
39)	IS/TEC60884-2-5): 1995 IEC60884-2-5:1995	Plugs and Socket-Outlets for Household and Similar Purposes Part 2 Particular Requirements D Section 5Adaptors		
40)	IS/IEC60998-I:2002	Connecting Devices for Low-Voltage Circuits for Household and Similar Purposes Part 1 General Requirements		
41)	IS/IEC61058-1 :2000 IEC61058-1:2000	Switches for appliances Part1general requirements		
42)	IS/IEC61537:2006 IEC61537:2006 IEC61537:2006	Cable Management-Cable Tray System and Cable Ladder System		
43)	IS/IEC62275:2018	Cable Management Systems-Cable ties for electrical installations		

ELECTRICAL LAMPS AND THEIR AUXILIARIES

Sl. No.	Standard	Title	Reaffirm Date	Amdt.
1)	IS 418:2004/ IEC60064(1993)	Tungsten filament lamps for domestic and similar general lighting purposes	2019	5
2)	IS2418(Part1): 2018/ IEC81(1974)	Tubular fluorescent lamps for general lighting service:Part1Requirements and tests (Second revision)	2018	(1)
3)	IS9900(Part1): 1981 / IEC188(1974)	High pressure mercury vapour lamps:Part1Requirements and test [Super seding IS 2183and IS 7023]	2017	(4)

4)	IS9974(Part1): 1981/ IEC662(1980)	High pressure sodium vapour lamps:Part1 General requirements and tests	2017	(1)
5)	IS1258:2005/IEC 61184 (1997)	Bayonet lamp holders Fourth Revision	2020	(4)
6)	IS3324:1982/IEC Pub 400 (1972)	Holders for starters for tubular fluorescent lamps First Revision	2018	
7)	IS2215:2006/IEC 60155(1993)	Starters for fluorescent lamps	2020	
8)	IS1534(Part 1): 1977 / IEC82(1973)	Ballasts for fluorescent lamps:Part1For switch start circuits	2011	(5)
9)	IS1569:1976/IEC 566	Capacitors for use in tubular fluorescent high-pressure mercury and low-pressure sodium vapour discharge lamp circuit	2016	(1)
10)	IS6616:1982/IEC 262 (1969)	Ballasts for high pressure mercury vapour Lamps	2011	(1)
LIGHT FITTINGS AND LUMINAIRES				
Sl. No.	Standard	Title	Reaffirm Date	Amdt.
1)	IS1913(Part 1): 1978	General and safety requirements for luminaires:Part1Tubular fluorescent lamps		
2)	*IS10322(Part 1):1982/ IEC598- 1(1979)	Luminaires:Part1General requirements	2020	
3)	IS10322(Part2): 1982 / IEC598- 1(1979)	Luminaires:Part2 Constructional Requirements	2010	
4)	IS10322(Part5/ Sec. 2):2012	Luminaires:Part5 Particular requirements, Sec2 Recessed luminaires (First Revision)	2012	
5)	IS 10322 (Part 5/ Sec.3):2012/IEC 60598-2-3(1979)	Luminaires: Part 5 Particular requirements, Sec3Luminairesforroadandstreetlighting (First revision)	2012	
6)	IS10322(Part5/Sec 4):1987/ IEC60598-2-4 (1979)	Luminaires:Part5 Particular requirements, Section 4 Portable general purpose	2010	1
7)	IS 10322(Part 5/ Sec 5):1987/IEC60598-2-5	Luminaires: Part 5 Particular requirements, Section5 Flood lights [superseding IS1947]	2010	(1)
8)	IS 3287:1965	Industrial lighting fittings with plastic reflectors	2005	
9)	IS1777:1978	Industrial luminaires with metal reflectors		
10)	IS2206(Part 1): 1984	Flame proof electric lighting fittings:Part1 Well-glass and bulkhead types	2005	
11)	IS 3528:1966	Waterproof electric lighting fittings	2015	
12)	IS 3553:1966	Water tight electric lighting fittings	2015	
13)	IS8030:1976/IEC 162 (1972)	Luminaires for hospitals	2013	
14)	IS 7537:1974	Road traffic signals	2018	
15)	IS9583:1981/ IEC598-2-22(1980)	Emergency lighting units	2018	
ELECTRICAL APPLIANCES				
Sl. No.	Standard	Title	Reaffirm Date	Amdt.
1)	IS302(Part1): 2008/ IEC60335-1(2006)	Safety of household and similar electrical appliances: Part 1 General requirements	2016	(4)
2)	IS 2268:1994	Electric call bells and buzzers for indoor use	2019	
3)	IS3412:1994	Electric water boilers	2016	
ELECTRICAL INSTRUMENTS				
Sl. No.	Standard	Title	Reaffirm Date	
1)	IS6236:2020/IEC 60258(1968)	Direct recording electrical measuring Instruments and Their Accessories (First Revision)		

2)	IS1248(Part1): 2021/ IEC60051-1(1997)	Direct acting indicating analogue electrical measuring instruments and their accessories: Part 1 Definitions and general requirements common to all parts Fifth Revision		
3)	IS1248(Part2): 2021/ IEC60051-2(1984)	Direct acting indicating analogue electrical measuring instruments and their accessories: Part 2 Special requirements for ammeters and voltmeters		
4)	IS1248(Part3): 2021/ IEC60051-3(1984)	Direct acting indicating analogue electrical measuring instruments and their accessories: Part3 Special requirements for Watt meters and varmeters		
5)	IS1248(Part4): 2003/ IEC60051-4(1984)	Direct acting indicating analogue electrical measuring instruments and their accessories: Part 4 Frequency meters	2018	
6)	IS1248(Part5): 2021/ IEC60051-5(1984)	Direct acting indicating analogue electrical measuring instruments and their accessories: Part 5 Special requirements for Phase meters, power factor meters and synchroscope		
7)	IS722(Part1): 1998	AC electricity meters: General requirement and tests	1991	
8)	IS722(Part 2): 1977	AC electricity meters:Part2 Single-phase whole-current watt-hour meters, Class 2	1991	
9)	IS722(Part 3): 1988	AC electricity meters: Part 3 Three-phase whole current and transformer operated and single-phase transformer operated watt-hour meters, class 2 Super seeded by: IS13010,IS13779	1991	
10)	IS722(Part 5): 1980	AC electricity meters: Part 5 Volt-ampere hour meters for restricted power factor range, class 3.5 Super seeded by: IS14415		
11)	IS722(Part7/Sec1): 1987	AC electricity meters:Part7Volt-ampere hour meters for full power factor range, Section 1 General requirements Super seeded by: IS14372		
12)	IS722(Part 8): 1972	AC electricity meters:Part8 Single-phase2- wire whole current watt-hour meter (class1.0) Superseededby: IS13010,IS13779	1991	
13)	IS722(Part 9): 1972	AC electricity meters: Part 9 Three-phase whole current and transformer operated watt- hour meters and single- phase two-wire transformer operated watt-hour meters (class1.0) Super seeded by: IS13010,IS13779	1991	
14)	IS8530:1977 IEC60211:1966	Maximum demand indicators (class 1)	2010	
15)	*IS 2992:1987	Insulation resistance testers, hand operated (magneto generator type)	2015	
16)	IS3010(Part 1):1965 IECDoc:23 (Secretariat)58	Specification for appliance-connectors and appliance-Inlets Non-Reversible Three-Pin Type Part-1 appliance-connectors		
17)	IS3010(Part 2):1965 IECDoc:23 (Secretariat)58	Specification for appliance-connectors and appliance-Inlets Non-Reversible Three-Pin Type Part-2 appliance-Inlets		

INSTRUMENT TRANSFORMERS

Sl. No.	Standard	Title	Reaffirm Date	Amdt.
1)	IS2705(Part1): 1992/ IEC60185(1966)	Current transformers: General Requirements		
2)	IS2705(Part2): 1992/ IEC60185(1966)	Current transformers:Part2 Measuring current transformers Super seeded by: IS16227(Part2): 2016/IEC 61869-2 : 2012	2017	
3)	IS2705(Part3): 1992/ IEC60185(1966)	Current transformers: Part 3 Protective current transformers	2012	
4)	IS2705(Part4): 1992/ IEC60185(1966)	Current transformers: Part 4 Protective current transformers for special purpose applications	2012	
5)	IS 6949:1973	Summation current transformers	2016	

FUSES

Sl. No.	Standard	Title	Reaffirm Date	Amdt.
1)	IS9224(Part 1):	Low voltage fuses: Part 1 General		

	1979	requirements[superseded by IS13703(Part 1)]		
2)	IS9224(Part 2): 1979	Low voltage fuses:Part2Supplementary requirements for fuses for industrial applications (superseding IS2208) [superseded by IS13703(part2/Section1)]		
3)	IS2086:1993	Carriers and bases used in rewirable type electric fuses for voltages upto 650 V	2019	(1)
4)	IS 9926:1981	Fuse wires used in rewirable type electric fuses upto 650 volts	2021	
5)	IS8187:1976/IEC 269-3 (1973)	D-type fuses Super seeded by: IS/IEC60269-3: 2010	2016	
MISCELLANEOUS				
Sl. No.	Standard	Title	Reaffirm Date	Amdt.
1)	IS 2551:1982	Danger notice plates	2020	
2)	IS2448(Part 1): 1963	Adhesive insulating tapes for electrical purposes : Part1Tapes with cotton textile substrates	2020	(5)
ELECTROTECHNICAL VOCABULARY				
Sl. No.	Standard	Title	Reaffirm Date	Amdt.
1)	IS1885(Part 1): 1961	Electrotechnical vocabulary:Part1 Fundamental Definitions	2017	(2)
2)	IS1885(Part9): 2019/ IEC60050 (446):1983	Electrotechnical Vocabulary:Part9 Electrical relays (Third revision)		
3)	IS1885(Part 11): 1966	Electrotechnical vocabulary: Part11Electrical Measurements Super seeded by: Completely Withdrawn	2017	
4)	IS1885(Part16/Sec 1):1968	Electrotechnical vocabulary:Part16 Lighting,Section1General aspects	2017	
5)	IS1885(Part16/ Sec. 2):1968	Electrotechnical vocabulary: Part 16 Lighting, Section 2 General illumination, lighting fittings and lighting for traffic and signaling	2017	
6)	IS1885(Part16/ Sec. 3):1967	Electrotechnical vocabulary: Part 16 Lighting,Section3Lamps and auxiliary apparatus	2017	
7)	IS1885(Part 17): 1979	Electrotechnical vocabulary:Part17 Switchgear and control gear	2017	
8)	IS1885(Part 32):2019/ IEC60050(461): 1984	Electrotechnical Vocabulary:Part32Electric cables (Second revision)		
SAFETY				
Sl. No.	Standard	Title	Reaffirm Date	Amdt.
1)	IS 4770:1991	Rubber Gloves for electrical purposes	2017	1
2)	IS 5424:1969	Rubber mats for electrical purpose (Superseded by IS 15652:2006)	2004	
NATIONAL ELECTRIC CODES				
Sl. No.	Standard	Title	Reaffirm Date	Amdt.
1)	NEC 2023	National Electric Code, 2023	2023	

3. The party should follow the following compliances and requirements related to Inter wiring and Internal wiring for 3 phase and single phase power distribution and installations as per IS 732 (2019)

CHAPTER 3

ELECTRIC POWER DISTRIBUTION AND WIRING

3.1 Introduction

The electric power will be received and distributed in a building, through following means:-

3.1.1 Cabling and switchgear to receive power.

The building is divided into convenient number of parts, each part served by a rising main system to distribute power vertically/horizontally.

3.1.2 Power flows from rising main through tap-off box to floor main board to final DBs and then to wiring.

3.1.3 Dedicated circuit for different loads such as lighting, HVAC, power plug loads shall be provided, wherever possible.

3.1.4 Rising main, which takes care of general lighting and power outlet load of the building, should have independent cables for lighting as well as power, wherever possible. Other loads like lifts, water pump sets, other motor loads are fed by independent cables of suitable capacity fed from properly designed essential/ non- essential LT power panels with suitably designed switchgear having necessary control and safety features.

3.1.5 Therefore, the distribution/wiring system essentially consists of provision of cables, switchgear, rising main, bus-ducting, earthing, laying of pipes/ conduits etc. (in surface or recess) based on proper detailed designing to decide on various sizes/ capacities of these components and various controls and safeties involved, to provide an efficient, reliable, safe and adequate electrical distribution and wiring system.

3.1.6 A typical schematic diagram of power distribution of a building is enclosed. (See Chapter 19 Fig. 2).

3.1.7 Fire Prevention – Lifesaving and Restricting Damages to the Property

Fire Survival (FS) cables shall be used where integrity of electric supply is important especially to save human life and where electric supply is required for evacuation operation during the fire instances. These cables are designed to withstand temperatures from 6500C to 9500C and for period upto 180 min along with additional protection against mechanical shock and water splash. The fire survival cable shall be used at following location as given below and additional requirement, if any as mentioned in NBC 2016 as amended up to date, CEA Regulation 2010 as amended up to date and

NEC 2023 :-

Application of FS cable			
NOTE – For more details, refer Annex A of IS 17505(Part 1) : 2020			
Sl No. (1)	System Description (2)	Cable Fire Rating Required (°C) (3)	Time for which System should Withstand (Minutes) (4)
(i)	Fire pumps	FS (950/FWS)	180
(ii)	Pressurization	FS (950/FWS)	180
(iii)	Smoke venting including its ancillary systems, such as dampers and actuators	950	60
(iv)	Fire-fighting shaft(staircase, lift, lift lobby)	FS (950/FWS)	180
(v)	Fireman's lifts (including all lifts)	FS (950/FWS)	180
(vi)	Exit signage lighting	950	120
(vii)	Emergency lighting	950	120
(viii)	Fire alarm system		
(a)	Conventional (zone-based system)	650	60
(b)	Intelligent addressable system	650	60
(ix)	Public address (PA) system (related to emergency voice evacuation and annunciation)	650	60
(x)	Magnetic door hold-open devices	650	60
(xi)	Lighting in fire command center and security room	FS (950/FWS)	180

3.2 System of Distribution and Wiring

3.2.1 The wiring shall be done from a distribution system through main and/or branch distribution boards. The system design and location of boards will be properly worked out.

3.2.2 Each main distribution board and branch distribution board shall be controlled by an incoming circuit breaker. Each outgoing circuit shall be controlled by a circuit breaker.

3.2.3 For non-residential and residential buildings as far as possible DBs shall be separate for light and power.

3.2.4 Only MCCB/MCB type main and branch distribution boards shall be used. HRC/ Rewireable type fuses shall not be used.

3.2.5 Three phase DBs shall not be used for final circuit distribution as far as possible.

3.2.6 'Power' wiring shall be kept separate and distinct from light wiring, from the level of circuits, i.e., beyond the branch distribution boards. Conduits for light/power wiring shall be separate.

3.2.7 Essential/non-essential/UPS distribution each will have a completely independent and separate distribution system starting from the main, switchboard upto final wiring for each system. As for example, conduit carrying non-essential wiring shall not have essential or UPS wiring. Wiring for essential and UPS supply will have their own conduit system. No mixing of wiring is allowed.

3.2.8 Generally, no switchboard will have more than one source of incoming supply. More than one incoming supply will be allowed only at main board with proper safety and interlocking so that only one source can be switched on at a time.

3.2.9 Each MDB/DB/Switch Board will have reasonable spare outgoing ways for future expansion.

3.2.10 Balancing of 3-phase circuit shall be done.

3.2.11 Power and light MCB distribution boards in office/ non-residential building should be of same size irrespective of number of circuits as far as possible in order to get aesthetic look.

3.3 Wiring

All flexible copper wires used shall have Class 2 copper conductor satisfying the resistance requirements of NEC 2023 Part 1 Section 17, Annex B.

3.3.1 Submain & Circuit Wiring

(a) Submain Wiring:

Submain wiring shall mean the wiring from one main/distribution switchboard to another.

(b) Circuit Wiring:

Circuit wiring shall mean the wiring from the distribution board to the 1st tapping point inside the switch box, from where point wiring starts.

3.3.2 Measurement of Submain and Circuit Wiring

(a) Circuit and submain wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths from end to end of conduit or channel as the case may be, exclusive of interconnections inside the switchboard etc. The increase on account of diversion or slackness shall not be included in the measurement.

(b) The length of circuit wiring with two wires shall be measured from the distribution board to the nearest switch box from which the point wiring starts. Looping of switch boxes also will be counted towards circuit wiring, measured along the length of conduit/channel.

(c) When wires of different circuits are grouped in a single conduit/ channel, the same shall be measured on linear basis depending on the actual number and sizes of wires run.

(d) Protective (loop earthing) conductors, which are run along the circuit wiring and the submain wiring, shall be measured on linear basis.

Note: Conduit carrying submain will not carry circuit/point wiring. Similarly, conduit carrying circuit wiring will not carry submain/point wiring. Conduit carrying point wiring will not carry submain/circuit wiring.

3.3.3 Measurement of Other Wiring Work

Except as specified above for point wiring, circuit wiring and submain wiring, other types of wiring shall be measured separately on linear basis along the run of wiring depending on the actual number and sizes of wires run.

3.4 Point Wiring

All flexible copper wires used shall have Class 2 copper conductor satisfying the resistance requirements of NEC 2023 Part 1 Section 17, Annex B

3.4.1 Definition

A point (other than socket outlet point) shall include all work necessary in complete wiring to the following outlets from the controlling switch or MCB.

(a) Ceiling rose or connector (in the case of points for ceiling/exhaust fan points, prewired light fittings, and call bells).

(b) Ceiling rose (in case of pendants except stiff pendants).

(c) Back plate (in the case of stiff pendants).

(d) Lamp holder (in the case of goose neck type wall brackets, batten holders and fittings which are not prewired).

3.4.2 Scope

Following shall be deemed to be included in point wiring:

(a) Conduit/channel as the case may be, accessories for the same and wiring cables between the switch box and the point outlet, loop protective earthing of each fan/ light fixture.

(b) All fixing accessories such as clips, screws, Phil plug, rawl plug etc. as required.

(c) Metal or PVC switch boxes for control switches, regulators, sockets etc, recessed or surface type, and phenolic laminated sheet covers over the same.

(d) Outlet boxes, junction boxes, pull-through boxes etc. but excluding metal boxes if any, provided with switchboards for loose wires/conduit terminations.

(e) Control switch or MCB, as specified.

(f) 3 pin or 6 pin sockets, ceiling rose or connector as required. (2 pin and 5 pin socket outlets shall not be permitted.)

(g) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.

(h) Bushed conduit or porcelain tubing where wiring cables pass through wall etc.

Note: In areas where false ceiling are provided, termination of wires should be at the fittings. flexible metallic conduits helically wound in galvanized steel from ceiling junction box to the fittings shall be provided duly coupled at both ends with GI couplers. This shall be included within the scope of point wiring.

(i) Interconnecting wiring between switches within the switch box on the same circuit.

(j) PVC conduit glands/ double check nuts at conduit terminations.

(k) Wire termination lugs at all terminations.

(l) Terminal blocks at switch boards and junction boxes.

3.4.3 Measurement

(a) Point Wiring (other than socket outlet points)

Unless and otherwise specified, there shall be no linear measurement for point wiring for light points, fan points, exhaust fan points and call bell points. These shall be measured on unit basis by counting, and classified as laid down in 3.4.4.

3.4.4 Classification

Points measured under 3.4.3 on unit basis shall be classified as under according to the type of building:

(a) **Residential Buildings**

(i) Group 'A' for point wiring for type I, type II and type III residential quarters and hostels.

(ii) Group 'B' for point wiring for type IV and above type of residential quarters and barracks.

(b) **Non-residential Buildings**

Group 'C' for all types of non-residential buildings such as offices, hospitals, laboratories, educational institutions, libraries etc.

(c) For any Other Type of Building

The group under which the points are to be classified shall be decided by the concerned Chief Engineer (Elect.).

3.4.5 Point Wiring for Socket Outlet Points

(a) The light plug (6 A) point and power (16 A) point wiring shall be measured on linear basis, from the respective tapping point of live cable, namely, switch box, another socket outlet point, or the subdistribution board as the case may be, up to the socket outlet.

(b) The metal/PVC box with cover, switch/MCB, socket outlet and other accessories shall be measured and paid as a separate item.

Note: There shall normally be no "on the board" light plug point.

(c) The power point outlet may be 16 A/6 A six pin socket outlet, where so specified in the tender documents.

3.4.6 Group Control Point Wiring

(a) In the case of points with more than one point controlled by the same switch, such points shall be measured, in parts i.e. (a) from the switch to the first point outlet as one normal point and classified according to 3.4.4, and (b) for the subsequent points as Group Controlled Points. The distance from that outlet to the next one and so on, shall be treated as separate point(s) and classified according to 3.4.4. There shall be no linear measurement for these Group Controlled Points and these shall be measured on unit basis by counting and classified as laid down in 3.4.4.

3.4.7 Twin Control Light Point Wiring

(a) A light point controlled by two numbers of two-way switches shall be measured as two points from the fitting to the switches on either side and classified according to 3.4.4.

(b) No recovery shall be made for non-provision of more than one ceiling rose or connector in such cases.

3.4.8 Multiple Controlled Call Bell Point Wiring

(a) In the case of call bell points with a single call bell outlet, controlled from more than one place, the points shall be measured in parts i.e.

(i) from the call bell outlet to one of the nearest ceiling roses meant for connection to bell push, treated as one point and classified according to 3.4.4, and

(ii) from that ceiling rose to the next one and so on, shall be treated as separate point(s) and classified according to 3.4.4.

(b) No recovery shall be made for non-provision of more than one ceiling rose or connector for connection to call bell in such cases.

3.5 Wiring System

3.5.1 Wiring shall be done only by the looping system. Phase/live conductors shall be looped at the switch box. For point wiring, neutral wire/earth wire looping for the 1st point shall be done in the switch box; and neutral/earth looping of subsequent points will be made from point outlets.

3.5.2 In wiring, no joints in wiring will be permitted anywhere, except in switch box or point outlets, where jointing of wires will be allowed with use of suitable connector.

3.5.3 The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of linked switchgear.

3.5.4 Light, fans and call bells shall be wired in the 'lighting' circuits. 15A/16A socket outlets and other power outlets shall be wired in the 'power' circuits. 5A/6A socket outlets shall also be wired in the 'power' circuit both in residential as well as non-residential buildings.

3.5.5 Colour Coding of Wiring:

Following colour coding shall be followed in wiring:

Phase : Red/Yellow/Blue.(Three phase wiring)

Live : Red (Single phase wiring)

Neutral : Black

Earth : Yellow/Green.

3.5.6 Termination of Circuit into Switchboard Circuit will consist of phase/neutral/earth wire. Circuit will terminate in a switch board (first tapping point, where from point wiring starts) in following manner: Phase wire terminated in phase connector. Neutral wire terminated in neutral connector. Earth wire terminated in earth connector.

The switchboard will have phase, neutral and earth terminal connector blocks to receive phase/neutral/ earth wire. See Fig 3.

3.6 Run of Wiring

3.6.1 The type of wiring shall be as specified in the tender documents namely, surface conduit/recessed conduit, steel/PVC, channel.

3.6.2 Surface wiring shall run as far as possible along the walls and ceiling, so as to be easily accessible for inspection.

3.6.3 Above false ceiling, in no case, open wiring shall be allowed. Wiring will be done in recessed conduit or surface steel conduit.

3.6.4 In recessed conduit system, routes of conduit will be planned, so that various inspection boxes provided don't present a shabby look. Such boxes can be provided 5 mm above plaster level, and they can be covered with plaster of Paris with marking of junction boxes.

3.6.5 Where number of electrical services like electrical wiring, telephone wiring, computer cabling, pass through corridors, it may be proper to plan such service with properly designed aluminium/PVC channels duly covered by a false ceiling, so that subsequently such service can be maintained and additional cables can be provided.

3.6.6 Generally, conduits for wiring will not be taken in floor slabs. When it is unavoidable special precaution to be taken to provide floor channels with provision for safety and maintenance.

Alternatively floor trunking (raceways) / false flooring can be provided.

3.7 Passing through Walls or Floors

3.7.1 When wiring cables are to pass through a wall, these shall be taken through a protection (steel/ PVC) pipe or porcelain tube of suitable size such that they pass through in a straight line without twist or cross in them on either porcelain, PVC or other approved material.

3.7.2 All floor openings for carrying any wiring shall be suitably sealed after installation.

3.8 Joints in Wiring

3.8.1 No bare conductor in phase and/or neutral or twisted joints in phase, neutral, and/ or protective conductors in wiring shall be permitted.

3.8.2 There shall be no joints in the through-runs of cables. If the length of final circuit or submain is more than the length of a standard coil, thus necessitating a through joint, such joints shall be made by means of approved mechanical connectors in suitable junction boxes.

3.8.3 Termination of multistranded conductors shall be done using suitable crimping type thimbles.

3.9 Ratings of Outlets

(to be adopted for design).

3.9.1 LED fittings shall be used in the buildings and the rated capacity shall be as per actuals subject to “each circuit shall not have more than 800 W connected load or more than 20 points whichever is less”.

3.9.2 Conventional Ceiling fans shall be rated at 60W and BLDC fans shall be rated as per the actuals. Exhaust fans, fluorescent tubes, compact fluorescent tubes, HPMV lamps, HPSV lamps, CFL fittings etc. shall be rated according to their capacity. Control gear losses shall also be considered as applicable.

3.9.3 6A and 16A socket outlet points shall be rated at 100W and 1000W respectively, unless the actual values of loads are specified.

3.10 Capacity of Circuits

3.10.1 Lighting circuit shall feed light/fan/call bell points. Each circuit shall not have more than 800 W connected load or more than 20 points whichever is less as because of introduction of LED lights, load on lighting circuit gets reduced drastically.

3.10.2 Power circuit in non-residential building will have only one outlet per circuit. However in nonresidential building for computer points 3 nos. 6A outlet sockets can be feed through power circuit.

3.10.3 Each power circuit in residential building can feed following outlets:

(a) Not more than 2 Nos. 16A outlets.

(b) Not more than 3 Nos. 6A outlets.

(c) Not more than 1 No.16A and 2 Nos. 6A outlets.

(d) Independent circuit each to feed Geyser, AC Outlet and Kitchen oven, washing machine outlets

3.10.4 Load more than 1 KW shall be controlled by suitably rated MCB and cable size shall be decided as per calculations.

3.10.5 Power Wiring with Bus Trunking

It is permitted to meet large-scale power requirement in a hall, or floor, with use of single phase or 3 phase bus bars running inside a metal enclosure. This will be provided with careful design and use of factory fabricated bus-trunking of reputed make, conforming to relevant BIS standards and with standard accessories like End feed unit, tap off with necessary safety features like over current, shortcircuit and earth fault protection. Such trunking will be of specified breaking KA rating.

3.11 Socket Outlets

3.11.1 Socket outlets modular type shall be 6A 3 pin, 16 Amp 3 pin or 16/6 Amp 6 pin. 5 pin socket outlets will not be permitted.

The third pin shall be connected to earth through protective earthing conductor. 2 pin or 5 pin sockets shall not be permitted to be used.

3.11.2 Conductors connecting electrical appliances with socket outlets shall be of flexible type with an protective earthing conductor for connection to the earth terminal of plug and the metallic body of the electrical appliance.

3.11.3 Sockets for the power outlets of rating above 1KW shall be of suitable rating modular switch/ socket configuration with controlling MCB.

3.11.4 Where specified, shutter type (interlocking type) of sockets shall be used.

3.11.5 Every socket outlet shall be controlled by a switch or MCB, as specified. The control switch/MCB shall be connected on the ‘live’ side of the line.

3.11.6 6A and 16A socket outlets shall be installed at the following positions, unless otherwise specified.

(a) Non-residential buildings –

(i) 6A socket outlet: 110 cm above floor level.

(ii) 16A socket outlet: 23 cm/ 110 cm above floor level.

(b) Kitchen/ Pantry:

6A/ 16A socket outlet – 23 cm above working platform and away from the likely positions of stove and sink.

(c) Bathroom:

6A socket outlet: Socket outlet for portable appliances like hair dryer, shaver etc. to be provided adjacent to wash basin/ mirror at 110 cm height above floor level.

For Geyser:

16A MCB in modular switch box arrangement be provided in bathroom at 110 cm height, adjacent to switchboard (for light and exhaust fan) with socket outlet at minimum 2mt. height from floor level and at least 60 cm. away from shower head adjacent to geyser (within 30 cm).

OR

16A MCB in modular box arrangement be provided in bathroom at 110 cm height at suitable location near door, with socket outlet at minimum 2mt. height from floor level and at least 60 cm. away from shower head adjacent to geyser (within 30 cm).

(d) Rooms in residences

(i) 6A socket outlet: 70 cm above floor level on bed side(s)

(ii) 6A socket outlet: for other locations, 23 cm/110 cm above floor level, or any other level in special cases as desired by the Engineer-in-charge.

(iii) 16A socket outlet –23 cm/110 cm above floor level, or any other level in special cases as desired by the Engineer-in-charge.

3.11.7 Unless and otherwise specified, the control switches for the 6A and 16A socket outlets shall be kept along with the socket outlets.

3.12 Cables

3.12.1 Copper conductor cable only will be used for submain/ circuit/ point wiring.

3.12.2 Minimum size of wiring:

Light Wiring :

Power Wiring : 4.0 sq.mm.

Power circuit rated : More than 1 KW, Size as per calculation.

3.12.3 Insulation : Copper conductor cable shall be PVC insulated conforming to BIS Specification

3.12.4 Multi stranded : Cables are permitted to be used. However, proper termination on the ends with lugs/ thimbles should be used.

3.13 Flexible Cable

3.13.1 Conductor of flexible cables shall be of copper. The cross-sectional area of conductor for flexible cable shall be as per design.

3.13.2 Only 3 core flexible cables shall be used for connecting single-phase appliances.

3.13.3 Unless the flexible cables are mechanically protected by armour, or tough rubber, or PVC sheath, these shall not be used in workshops and other places where they are liable to mechanical damage.

3.13.4 Flexible cable connection to bell push from ceiling rose shall be taken through steel conduit/metallic casing and capping.

3.14 Wiring Accessories

3.14.1 Control Switches for Point

(a) Control switches (single pole switch) carrying not more than 16A shall be modular type. The switch shall be 'On' when the knob is down.

(b) (i) In type II & III quarters, Barracks & school buildings (except principal's & staff rooms) etc. Modular type switches and sockets should be used.

(ii) Modular type switches and sockets to be provided for remaining types of buildings i.e. in all types of remaining non-residential buildings & residential buildings of type IV & above & Transit hostel or as may be decided by the Architect/ user department.

(c) It is recommended to provide MCB in Modular type boxes with controlling MCB for window type, split type AC units, geysers etc. The location of the controlling MCB and related socket should can be at separate location depending upon type of gadget. For example, in case of geyser/ split AC the socket can be near the geyser/ indoor split unit and switch/ controlling MCB can be at different location at approachable height.

Note: The advisory issued vide No. DG/SE(E)TAS/SPECIFICATIONS/06 dated 30.11.2021 as enclosed at Chapter 17 – Appendix-L to be referred to.

3.14.2 Specification of Modular Switches and socket

The modular switch shall be as per following/ have features mentioned below: -

- Suitable for 240V, AC, with normal gap constructions, Flush type, Screw type terminal, IP20
- Current carrying plastic parts of Nylon (PA6) with glass fibres up to 16A
- Non-Flammable insulating parts & very high Insulating resistance after Humidity test.
- Marked with IS 3854:1997
- Snap fit with Modular Plates very easy to install
- Arrow marking for correct orientation with plate.
- Double rocker mechanism to prevent visible spark.
- Bimetal Silver contact tips for less spark & longer life.
- Fire retardant and UV stabilized.

The modular sockets shall be as per following/ have features mentioned below:-

- 240V, AC, Flush type, Screw type terminal, Shuttered.
- Polycarbonate material thickness ~1.5 mm to 2.5 mm
- Non-Flammable insulating parts & very high Insulating resistance after Humidity test.
- 6A, 6/16A Socket market with ISI, as per IS1293:2019
- Snap fit with Modular Plates easy to install
- Brass current carrying parts.
- Fire retardant and UV stabilized.

3.14.3 Switch Box

(a) Switch box shall be hot dip galvanized, factory fabricated, suitable in size for surface/ recess mounting and suitable in size for accommodating the required number of switches and accessories (where required to be used for applications other than modular switches/ sockets).

(b) Switch box also can be of non-metallic material. The technical sanctioning authority will approve specified makes of reputed quality and specifications.

3.14.4 Switch Box Covers (for application other than modular type)

Phenolic laminated sheets of approved shade shall be used for switch box covers. These shall be of 3 mm thick synthetic phenolic resin bonded laminated sheet as base material and conforming to grade P- I of IS 2036: 1995.

Note: Specification for switch boxes is covered in the chapters on the various types of wiring.

3.14.5 Ceiling Rose

(a) A ceiling rose shall not be used on a circuit, the voltage of which normally exceeds 250V.

(b) Only one flexible cord shall be connected to a ceiling rose. Specially designed ceiling roses shall be used for multiple pendants.

(c) A ceiling rose shall not embody fuse terminal as an integral part of it.

3.14.6 Lamp Holders

3.14.7

(a) Lamp holders may be batten, angle, pendant or bracket holder type as required. The holder shall be made of brass/ ABS Plastic material/ Bakelite (ISI marked) and shall be rigid enough to maintain shape on application of a nominal external pressure. There should be sufficient threading for fixing the base to the lamp holder part so that they do not open out during attention to the lamp or shade.

(b) Lamp holders for use on brackets and the like shall have not less than 1.3 cm nipple, and all those for use with flexible pendant shall be provided with cord grips.

(c) All lamp holders shall be provided with shade carriers.

(d) Where centre contact Edison Screw lamp holders are used, the outer or screw contact shall be connected to the 'middle wire', or the neutral conductor of the circuit.

3.14.8 Fittings

(a) Types: The type of fittings shall be as specified in tender documents. The fitting proposed shall be compliant to the related Bureau of Indian Standards (BIS) as applicable, including LED fittings.

(b) Indoor Type Fittings

(i) Where conductors are required to be drawn through tube or channel leading to the fitting, the tube or channel must be free from sharp angles or projecting edge, and of such size as will enable them to be wired with the conductors used for the final circuit without removing the braiding or sheathing. As far as possible all such tubes or channels should be of sufficient size to permit looping back.

(ii) Wires used within prewired fittings shall be flexible with PVC insulation and 14/0.193 mm (minimum) copper conductors. The leads shall be terminated on built-in-terminal block, ceiling rose or connector, as required.

(iii) Fittings using discharge lamps shall be complete with power factor correction capacitors, either integrally or externally. An earth terminal with suitable marking shall be provided for each fitting for discharge lamps.

(iv) Fittings shall be installed such that the lamp is at a height of 2.4m above floor level, unless otherwise directed by the Engineer-in-charge.

(v) Fittings made of CRCA shall be phosphatized and powder/epoxy painted. For coastal areas and humid area like toilets, kitchen, for prolonging the life of such fittings, corrosion free materials like engineering plastic, aluminium, stainless steel etc. should be used.

(c) Outdoor Fittings

Outdoor fittings shall have suitable IP protection. It is preferable that street light fittings are of cast aluminium body of minimum IP 65, for reducing recurring maintenance cost and improved performance. Where ever required IP 66 fittings also can be provided for reducing maintenance frequency and cost.

Other fittings, which are not available with tested IP 65/54 protection, can be properly fabricated with weatherproof features, proper gasketing etc. As far as possible corrosion free material like cast aluminium, stainless steel, engineering plastics may be used for fabrication of such fittings, to prolong life of such fittings. There should not be any exposed wiring in such outdoor fittings.

3.15 Attachment of Fittings and Accessories

3.15.1 Conduit Wiring System

(a) All accessories like switches, socket outlets, call bell pushes and regulators shall be fixed in flush pattern inside the switch/regulator boxes. Accessories like ceiling roses, brackets, batten holders etc. shall be fixed on outlet boxes. The fan regulators may also be fixed on outlet boxes, if so directed by the Engineer-in-charge.

(b) Aluminium alloy or cadmium plated iron screws shall be used to fix the accessories to their bases.

(c) The switch box/regulator box shall normally be mounted with their bottom at 1.1 m from floor level, unless otherwise directed by the Engineer-in-charge.

3.15.2 Fixing to Walls and Ceiling

(a) Wooden plugs for fixing to wall/ceiling will not be allowed. Fixing will be done with the help of PVC sleeves/Rowel plugs/ dash fasteners as required.

(b) Drilling of holes shall be done by drilling machines only. No manual drilling of hole will be allowed.

3.16 Fans, Regulators and Clamps

3.16.1 Ceiling Fans

(a) Ceiling fans including their suspension shall conform to relevant Indian Standards.

(b) The capacity of a ceiling fan to meet the requirement of a room with the longer dimension D meters should be about 55 D m³/min.

(c) The height of fan blades above the floor should be $(3H + W)/4$, where H is the height of the room, and W is the height of the work plane.

(d) The minimum distance between fan blades and the ceiling should be about 0.3 meters.

(e) When actual ventilated zone does not cover the entire room area, then optimum size of ceiling fan should be chosen based on the actual usable area of the room, rather than the total floor area of the room.

(f) The number of fans and the optimum sizes for rooms of different dimensions are given in the table 3.1:

Table 3.1

OPTIMUM SIZE/NUMBER OF FANS FOR ROOMS OF DIFFERENT SIZES

Room Width	Room Length										
	4m	5m	6m	7m	8m	9m	10m	11m	12m	14m	16m
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
3	1200/1	1400/1	1500/1	1050/2	1200/2	1400/2	1400/2	1400/2	1200/3	1400/3	1400/3

4	1200/1	1400/1	1200/2	1200/2	1200/2	1400/2	1400/2	1500/2	1200/3	1400/3	1500/3
5	1400/1	1400/1	1400/2	1400/2	1400/2	1400/2	1400/2	1500/2	1400/3	1400/3	1500/3
6	1200/2	1400/2	900/4	1050/4	1200/4	1400/4	1400/4	1500/4	1200/6	1400/6	1500/6
7	1200/2	1400/2	1050/4	1050/4	1200/4	1400/4	1400/4	1500/4	1200/6	1400/6	1500/6
8	1200/2	1400/2	1200/4	1200/4	1200/4	1400/4	1400/4	1500/4	1200/6	1400/6	1500/6
9	1400/2	1400/2	1400/4	1400/4	1400/4	1400/4	1400/4	1500/4	1400/6	1400/6	1500/6
10	1400/2	1400/2	1400/4	1400/4	1400/4	1400/4	1400/4	1500/4	1400/6	1400/6	1500/6
11	1500/2	1500/2	1500/4	1500/4	1500/4	1500/4	1500/4	1500/4	1500/6	1500/6	1500/6
12	1200/3	1400/3	1200/6	1200/6	1200/6	1400/6	1400/6	1500/6	1200/7	1400/9	1400/9
13	1400/3	1400/3	1200/6	1200/6	1200/6	1400/6	1400/6	1500/6	1400/9	1400/9	1500/9
14	1400/3	1400/3	1400/6	1400/6	1400/6	1400/6	1400/6	1500/6	1400/9	1400/9	1500/9

Note: This table is indicative only. Case specific design should be done by field officers based on site conditions & constraints.

(g) Performance values of fans as per Table below and other test parameters such as speed, input watt, power factor etc. shall be corresponding to the highest speed achievable from remote control or regulator. Any other devices or speed regulation features, if provided, shall be suitably set to achieve the highest speed. (*refer IS 374:2019, Amendment-1-2022*).

Energy Efficient fans with BEE 3–5-star rating or complying with IS 374: 1979, shall be used. The minimum service value of fans shall be 3.5 m³/min/W and air delivery 200 m³/min.

The values of service factor and air delivery for ceiling fans with 1200 mm sweep are given in the table 3.2:

Table 3.2

Performance Value of Fans

Sl No. (1)	FanSize mm (2)	MinimumAirDelivery m ³ /min (3)	MinimumServiceValue m ³ /min/W (4)
1.	600	100	1.5
2.	>600 and ≤ 750	115	1.7
3.	>750 and ≤ 900	130	3.1
4.	>900 and ≤ 1 050	150	3.1
5.	>1 050 and ≤ 1 200	210	4.0
6.	>1 200 and ≤ 1 320	220	4.0
7.	>1 320 and ≤ 1 400	245	4.1
8.	>1 400 and ≤ 1 500	270	4.3

NOTES:

(i) Air delivery values are on the basis of air velocity measurement up to 15 m/min.

(ii) However In Hostel, Barracks a, Number of fans shall also be decided taken into account the location of furniture layout etc.

(h) Two module Step type electronic regulators should be used instead of resistance type regulators for controlling speed of fans

(i) All ceiling fans shall be wired to ceiling roses or to special connector boxes, and suspended from hooks or shackles, with insulators between hooks and suspension rods. There shall be no joint in the suspension rod.

(j) For wooden or steel joists and beams, the suspension shall consist of GI flat of size not less than 40 mm x 6 mm, secured on the sides of the joists or beams by means of two coach screws of size not less than 5 cm for each flat. Where there is space above the beam, a through-bolt of size not less than 1.5 cm dia, shall be placed above the beam from which the flats are suspended. In the latter case, the flats shall be secured from movements by means of another bolt and nut at the bottom of the beam. A hook consisting of MS rod of size not less than 1.5 cm dia shall be inserted between the MS flat through oval holes on their sides. Alternatively, the flats may be bent inwards to hold tightly between them by means of a bolt and nut, a hook of 'S' form.

(k) In the case of 'I' beams, flats shall be shaped suitably to catch the flanges and shall be held together by means of a long bolt and nut.

(l) For concrete roofs, a 12 mm dia. MS rod in the shape of 'U' with their vertical legs bent horizontally at the top at least 19 cm on either side, and bound to the top reinforcement of the roof shall be used, as shown in Fig. 4.

(m) In buildings with concrete roofs having a low ceiling height, where the fan clamp mentioned under sub-clause (v) above cannot be used, or wherever specified, recessed type fan clamp inside metallic box, as shown in Fig. 5 shall be used.

(n) Canopies on top of suspension rod shall effectively hide the suspension.

(o) The leading in wire shall be of nominal cross-sectional area not less than 1.5 sq. mm. and shall be protected from abrasion.

(p) Unless otherwise specified, all ceiling fans shall be hung 2.75 m above the floor.

(q) In the case of measurement of extra down rod for ceiling fan including wiring, the same shall be measured in units of 10 cm. Any length less than 5 cm shall be ignored.

(r) The wiring of extra down rod shall be paid as supplying and drawing cable in existing conduit.

3.16.2 Exhaust Fans

(a) Exhaust fans shall conform to relevant Indian Standards.

(b) Exhaust fans shall be erected at the places indicated by the Engineer-in- charge. For fixing an exhaust fan, a circular opening 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 to the original finish of the wall. The exhaust fan shall be connected to the exhaust fan point, which shall be wired as near to the opening as possible, by means of a flexible cord, care being taken to see that the blades rotate in the proper direction.

(c) Exhaust fans for installation in corrosive atmosphere, shall be painted with special PVC paint or chlorinated rubber paint.

(d) Installation of exhaust fans in kitchens, dark rooms and such other special locations need careful consideration; any special provisions needed shall be specified.

3.16.3 Regulators

The metallic body of regulators of ceiling fans/exhaust fans shall be connected to earth by protective conductor.

3.17 Marking of Switch Boards

3.17.1 Schematic Diagram

First a comprehensive schematic diagram for each building is to be prepared, starting from Main LT Panel, rising main, submain boards, DBs, etc. and the manner in which they are connected. This will include essential, non-essential and UPS systems. Sizes of interconnecting main/submain cables shall be indicated.

3.17.2 Marking of each Main Board

Each main board/submain board shall be marked indicating rating of each incoming/ outgoing switch and the details of load/area it feeds. Detail/size of incoming and outgoing cable also shall be marked indicating from where the incoming cable has originated.

3.17.3 Marking of Distribution Board

Each Distribution Board shall be marked indicating detail of incoming switch (Size of cable and from where it is fed) and marking of each outgoing MCB indicating the area it feeds. Suitable marking sticker will be suitably fixed to indicate such details.

3.17.4 Marking of Power/Light DBs

Power/light DBs shall be marked 'P' and 'L' respectively.

3.17.5 Marking for Non-essential/Essential/UPS/Switch Boards

Each switchboard shall be marked essential/non-essential/UPS to indicate the nature of such switchboards.

3.17.6 Marking of Main Earthing Terminal

Main Earthing terminals in main/submain switchboard shall be permanently marked, as "Safety Earth – Don't Remove".

3.18 LT Distribution Switchgear

Only following type switchboards will be used:

3.18.1 Main/Submain switchboard of cubicle type.

3.18.2 DBs shall have incoming and outgoing terminal blocks with factory pre-wiring up to outgoing terminal blocks having phase/neutral/Earth terminal block for each circuit. This is to minimise chance of loose wiring which is a potential fire hazard. Conventional DBs of reputed makes with factory fabricated loose wire box with terminal blocks can also be used with the approval of technical sanctioning authority/NIT authority in addition to pre wired DBs. (See fig 8)

3.18.3 Specially designed switchboards.

Also specially designed switchboards can be used with detailed specification and fabrication drawings approved by the technical sanctioning authority.

3.18.4 Specifications of Cubicle Panel given in Chapter 7.

3.19 Location of Switchboards

3.19.1 Switchboards are to be located in common areas like corridors, lobby etc. and not to be located in locked room.

3.19.2 Switchboard shall be located only in dry situation and in well-ventilated space. They shall not be placed in the vicinity of storage battery or exposed to chemical fume.

3.19.3 Switchboards shall not be erected above gas stove, or sinks or within 2.5 meter of any washing unit in washing rooms of laundrerings or in the bath rooms, toilets, or kitchen.

3.19.4 As far as possible main boards shall not be located in basement. Such main boards can be located in ground floor.

3.19.5 It is preferable to locate floor main boards in rising main shafts of adequate size, with steel doors (having ventilation) or in suitable room.

3.19.6 Similarly, DBs can be in suitable niches in corridor walls having doors.

3.19.7 Locating main boards under staircase or standing open in corridor is not a desirable practice, besides being highly unesthetic.

3.19.8 The main switchboard, which receives power to the building, should be invariably located in a switch room, having round the clock access, for emergency attendance to the switchboard.

3.20 Guidelines for Planning Residential Areas

3.20.1 U.G. System of Power Distribution, Street Lighting, Telephone Cabling and TV Cabling

For long-term economical maintenance, better reliability of service, safety, protection against heavy rains, storm, wind etc. and aesthetics, underground cable system will be generally followed. Also considering the high cost of land, underground system results in better economic utilization of land area, otherwise substantial land route has to be earmarked for overhead lines.

3.20.2 Efficient working of street lights and staircase lighting is required for security of the colony and safety and convenience of the residents. Therefore, adequate street lighting, staircase lighting is to be provided. Generally back lanes of residential blocks remain dark. Such areas are also to be covered by basic street lighting for security.

3.20.3 Kitchen

(a) Exhaust fans opening with one point outlet to be provided irrespective of yardstick of provision of exhaust fans.

(b) In addition to one 16 A 6-pin power outlet for kitchen, one 3 pin 6 Amp. outlet to be provided for water filter.

3.20.4 Washing Machine

Location to be finalized in consultation with the Architect. A power outlet plus water supply/drainage to be coordinated with Architect/Civil Engineer.

3.20.5 Meter Board

(For a Block of Quarters)

Generally, for a block of quarters of 2/3/4 storied, electric supply for each block is received in a meter board, where a cubicle meter panel is provided with system of power distribution to each quarter. (Chapter – 19 See Fig. 6)

At present such meter boards are invariably located under staircase. This is not a desirable practice from technical/aesthetic viewpoint.

It is technically desirable to coordinate with Architect to provide separate meter room for each block of quarters or a number of blocks.

3.20.6 Stair Case Lighting

Stair case lighting is to be treated as an extension of street lighting, for security and convenience of the residents. LED light fitting for staircase lighting may be provided to reduce load. Incandescent stair case lighting and bulk head fittings should not be provided, in view of excessive energy consumption and low burning hours.

3.20.7 Emergency Electric Supply

For ensuring essential water supply and security lighting, a D.G. set to be provided for each colony to take care of water supply pump set, sewerage pump set, street lighting and essential load requirement of buildings like CGHS Dispensary, Community Centre etc.

3.20.8 Fittings

Subject to limit of yardstick of fittings for various types of quarters following guidelines to be provided:

- (a) Every room to be provided with one LED batten fitting for energy saving.
- (b) Kitchen to be provided with a LED batten fitting.
- (c) Incandescent bulkhead fittings not to be used.
- (d) Quality fittings of reputed make to be used.
- (e) Colour temperature of LED Lights to be used should be specified in the NIT.

3.20.9 Main Board of Each Quarter

It shall be MCB type with provision of ELCB with the incoming MCB. It shall be located in a niche with ventilated door cover, in the room connecting to the entry of the quarter. MCB DB shall be double door type.

3.20.10 Corrosion Free Fittings

Coastal areas and humid areas like kitchen, toilet are subject to corrosion, which substantially reduces the useful life of such fittings, besides giving an ugly look on account of rusting.

Therefore, for coastal areas, and other humid areas corrosion free type of fittings (like aluminium, stainless steel, engineering plastic) should be used, for ensuring long life of such fittings and to achieve life cycle economy, after taking into account recurring expenditure on account of painting of fittings.

3.20.11 Telephone Wiring

Telephone wiring is to be provided for each quarter. Such telephone wiring to be brought to a tagblock at a suitable point in ground floor. Provisions shall be kept for suitable entry-pipe for laying incoming telephone cable. The number of telephone points shall be as per scale of amenities for electrical installation in general pool residential accommodation.

3.20.12 TV Cabling

Internal TV cabling shall be provided,. Similarly, from suitable point at ground floor, TV cabling shall be provided. With use of suitable splitters, such TV cabling to be connected to each quarter.

The number of TV points shall be as per scale of amenities for electrical installation in general pool residential accommodation.

3.20.13 Lighting for Parks

Colonies are provided with parks. Such parks should be provided with adequate lights to include area lights, pathway lights etc. so that the parks can be effectively used by the residents and they remain secure during night time

3.20.14 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.

3.20.15 Preliminary Estimate to Take Care of Telephone/TV Cabling in a Colony

At present, such services are provided in a very crude manner making use of existing poles and hanging cables. Apart from making colonies shabby, such services are subject to damages and unsatisfactory service. Therefore, preliminary estimate should provide for such TV/Telephone cabling for the colony.

3.20.16 Other Allied Services

Modern residential colonies require support services like CCTV (for Gate and house security), intercom system, basic security system etc. for the safety and convenience of the residents.

Therefore, preliminary estimate should provide for basic provisions for such safety/security systems.

Most of these services pay for themselves within 3 / 4 years of installation, besides providing security, which sometimes amount to life saving instances.

3.21 Guidelines for Planning Office Buildings

3.21.1 The main objective is to provide safe, efficient, reliable electricity with measures to avoid possible fire hazards, which calls for sound detailed designing and use of quality equipment and materials executed with sound workmanship and supervision.

3.21.2 All control LT Panels, controlling power supply to the entire building will be located in a centralized room, from where centralized control and monitoring of the entire power supply system can be made.

3.21.3 Earth fault protection shall be provided for each individual building at the LT receiving point i.e. Main LT Panel. RCD/ RCCB shall be used as per the provisions of CEA (Measures related to Safety and Electric supply) Regulations.

3.21.4 Office buildings are prone to fire hazard during night hours. Therefore, after office hours, all the LT Panels should be switched off. Based on need of the building, only the specified LT panel to be kept 'ON' which feed the loads during night hours. Such panel, called common service panel, may feed following loads, which are normally used after office hours: -

- (a) Some specified lifts.
- (b) Staircase/ Corridor/ Compound light.
- (c) Fire protection loads.
- (d) Pump Sets.
- (e) Other loads which are kept 'ON' after office hours.

3.21.5 Reliability of Power Supply

Minimum two transformers to be provided to provide certain redundancy.

3.21.6 It is preferable to plan for a separate service building, to combine all electrical and mechanical services of the building, so that the services can be maintained comprehensively at a lower cost and also reducing the overall area requirement. Such service building can combine electric sub-station, DG Sets, UPS, Air- conditioning Plant, water supply pump sets, etc.

3.21.7 While planning, maintainability of various services to be ensured, like providing facilities like access, approachability of various equipment, maintenance space etc.

3.22 Mandatory test for wire :

This Mandatory Test is applicable for original works only (original Works means all new constructions, site preparation, additions and alterations, special repairs to newly purchased or previously abandoned buildings or structures, including re-modelling or replacement).

The Acceptance Test as mentioned in IS 694-2010 (Reaffirmed 2020) shall constitute the mandatory test for wires non-metallic rigid conduit :

Acceptance tests:

- (a) Annealing test (for copper)
- (b) Tensile test (for aluminium)
- (c) Wrapping test (for aluminium)
- (d) Conductor resistance test
- (e) Test for thickness of insulation
- (f) Tensile strength and elongation at break of insulation
- (g) Insulation resistance test
- (h) High voltage test or spark test
- (i) Flammability test
- (j) Oxygen index test
- (k) Test for temperature index
- (l) Test for halogen acid gas evaluation
- (m) Test for smoke density rating
- (n) Persulphate test (for tinned copper conductor cable only)

CHAPTER 5

NON-METALLIC CONDUIT WIRING SYSTEM

5.1 Scope

This chapter covers the detailed requirements for wiring work in non-metallic conduits. This chapter covers both surface and recessed types of wiring work.

5.2 Application

5.2.1 Recessed conduit

Recessed conduit work is generally suitable for all applications. Surface conduit work may be adopted in places like workshops etc. and where recessed work may not be possible to be done. The type of work shall be as specified in individual works.

5.2.2 Flexible non-metallic conduits

Flexible non-metallic conduits shall be used only at terminations, wherever specified.

5.2.3 Special Precautions

- (a) If the pipes are liable to mechanical damages, they should be adequately protected.
- (b) Non-metallic conduit shall not be used for the following applications: -
 - (i) In concealed/inaccessible places of combustible construction where ambient temperature exceeds 60 degrees C.
 - (ii) In places where ambient temperature is less than 5 degrees C.
 - (iii) For suspension of fluorescent fittings and other fixtures.
 - (iv) In areas exposed to sunlight.

5.3 Materials

5.3.1 Conduits

(a) All non-metallic conduit pipes and accessories shall be of suitable material complying with IS 9537 (Part 3): 1983 (Reaffirmed 2017) and IS 3419:1988 (Reaffirmed 2017) for rigid conduits and IS 9537 (Part 5):2000 (Reaffirmed 2020) for flexible conduits. The interior of the conduits shall be free from obstructions. The rigid conduit pipes shall be ISI marked.

(b) The conduits shall be circular in cross-section. The conduits shall be designated by their nominal outside diameter. The dimensional details of rigid non-metallic conduits are given in Table 5.1 below.

(c) No non-metallic conduit less than 20 mm in diameter shall be used.

(d) Wiring Capacity

The maximum number of PVC insulated aluminium/copper conductor cables of 650/1100 V grade conforming to IS 694: 2018 that can be drawn in one conduit of various sizes is given in Table 4.1 under clause 4.3.1 (c). Conduit sizes shall be selected accordingly.

5.3.2 Conduit Accessories

- (a) The conduit wiring system shall be complete in all respect including accessories.
- (b) Rigid conduit accessories shall be normally of grip type.
- (c) Flexible conduit accessories shall be of threaded type.
- (d) Bends, couplers etc. shall be solid type in recessed type of works, and may be solid or inspection type as required, in surface type of works.
- (e) Saddles for fixing conduits shall be heavy gauge non-metallic type with base.
- (f) The minimum width and the thickness of the ordinary clips or girder clips shall be as per Table 5.2.
- (g) For all sizes of conduit, the size of clamping rod shall be 4.5 mm (7 SWG) diameter.
- (h) All accessories of non-metallic conduit like junction box, bend etc. shall be ISI marked only (IS 3419:1988 (Reaffirmed 2017) for non metallic rigid conduits and BIS 3837:1976, Reaffirmed 2006, Accessories for Rigid non metallic Conduit).

5.3.3 Outlets

- (a) The switch box shall be made of either rigid PVC moulding, or mild steel, or cast iron on all sides except at the front. The regulator boxes shall however be made only of mild steel or cast iron.
- (b) PVC boxes shall comply with the requirements laid down in IS 14772: 2020. These boxes shall be free from burrs, fins and internal roughness.
- (c) The thickness of the walls and base of PVC boxes shall not be less than 2 mm. The clear depth of PVC boxes shall not be less than 60 mm.
- (d) The specifications for metallic boxes shall be as per requirements of clause 4.2.3.
- (e) 3 mm thick phenolic laminated sheet covers for all types of boxes shall be as per requirements of clause 3.14(c).
- (f) The modular switch boxes shall be of required number of modules, made of GI sheet steel/ PVC and compliant to relevant BIS.

5.4 Installation

5.4.1 Common Aspects for Both Recessed and Surface Conduit Works

- (a) The erection of conduits of each circuit shall be completed before the cables are drawn in.
- (b) Conduit Joints
 - (i) All joints shall be sealed/cemented with approved cement. Damaged conduit pipes/fittings shall not be used in the work. Cut ends of conduit pipes shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductors while pulling them through such pipes.
 - (ii) The Engineer-in-charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc. after they have been prepared shall be submitted for inspection before being fixed.

(c) Bends in Conduit

- (i) All bends in the system may be formed either by bending the pipes by an approved method of heating, or by inserting suitable accessories such as bends, elbows or similar fittings, or by fixing non-metallic inspection boxes, whichever is most suitable. Where necessary, solid type fittings shall be used.
- (ii) Radius of bends in conduit pipes shall not be less than 7.5 cm. No length of conduit shall have more than the equivalent of four quarter bends from outlet to outlet.
- (iii) Care shall be taken while bending the pipes to ensure that the conduit pipe is not injured, and that the internal diameter is not effectively reduced.

(d) Outlets

All switches, plugs, fan regulators etc. shall be fitted in flush pattern. The fan regulators can be mounted on the switch box covers, if so stipulated in the tender specifications, or if so directed by the Engineer-in-charge.

(e) Painting

After installation, all accessible surfaces of metallic accessories shall be painted in compliance with clauses under Chapter 15 "Painting".

5.4.2 Additional Requirements for Surface Conduit Work

- (a) Conduit pipes shall be fixed by heavy gauge non-metallic saddles with base, secured to suitable approved plugs with screws in an approved manner, at an interval of not more than 60 cm, but on either side of couplers or bends or similar fittings, saddles shall be fixed at a closer distance from the centre of such fittings. Slotted PVC saddles may also be used where the PVC pipe can be pushed in through the slots.
- (b) Where the conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips as required by the Engineer-in-charge. Where it is not possible to use these for fixing, suitable clamps with bolts and nuts shall be used.
- (c) If the conduit pipes are liable to mechanical damage, they shall be adequately protected.

5.4.3 Additional Requirements for Recessed Conduit Work

(a) Making Chase

Requirements under clause 4.3.3 (i) shall be complied with.

(b) Fixing Conduits in Chase

- (i) The conduit pipe shall be fixed by means of staples, or by means of non-metallic saddles, placed at not more than 60 cm apart, or shall be fixed by any other approved means of fixing.
- (ii) At either side of the bends, saddles/staples shall be fixed at a distance of 15 cm from the centre of the bends.

(c) Erection in RCC Work

Requirements under clause 4.3.3 (iii) shall be complied with.

(d) Fixing Inspection Boxes

Requirements under clause 4.3.3 (iv) shall be complied with.

(e) Fixing Switch Boxes and Accessories

Requirements under clause 4.3.3 (v) shall be complied with.

(f) Fish Wire

Requirements under clause 4.3.3 (vi) shall be complied with.

(g) Bunching of Cables

For ease of maintenance, cables carrying direct current or alternating current shall always be bunched so that the outgoing and return cables are drawn in the same conduits.

5.4.4 Earthing Requirements

(a) A protective (earth) conductor shall be drawn inside the conduit in all distribution circuits to provide for earthing of non-current carrying metallic parts of the installation. These shall be terminated on the earth terminal in the switch boxes, and/or earth terminal blocks at the DBs.

Gas or water pipe shall not be used as protective conductors (earth medium).

TABLE 5.1
Dimensional Details of Rigid Non-metallic Conduits
[Clause 5.2.1(ii)]

(All dimensions in mm)

S. No.	Nominal Outside Diameter (in mm)	Maximum Outside Diameter (in mm)	Minimum Inside Diameter (in mm)	Maximum Permissible Eccentricity (in mm)	Minimum Permissible Ovality (in mm)
1.	20	20 +0.3	17.2	0.2	0.5
2.	25	25 +0.3	21.6	0.2	0.5
3.	32	32 +0.3	28.2	0.2	0.5
4.	40	40 +0.3	35.8	0.2	0.5
5.	50	50 +0.3	45.0	0.4	0.6

TABLE 5.2
Ordinary Clips or Girder Clips
[Clause 5.2.2(vi)]

Size of Conduit	Width	Thickness
(1) 20 mm & 25 mm	19 mm	20 SWG (0.9144mm)
(2) 32 mm & above		18 WG (1.219mm)

5.5 Mandatory test :

This Mandatory Test is applicable for original works only (original Works means all new constructions, site preparation, additions and alterations, special repairs to newly purchased or previously abandoned buildings or structures, including re-modelling or replacement).

The Acceptance Test as mentioned in IS 9537- Part 3: 1983 (Reaffirmed 2017) shall constitute the mandatory test for non-metallic rigid conduit :

(a) Dimension Test

(b) Bending Test

(c) Compression Test

(d) Resistance to Heat test

(e) Resistance to Burning Test

(f) Electrical Characteristics Test

CHAPTER 7
Power switchgear and control gear assemblies (PSC-Assemblies)
(LT Panels), D.B., Rising Mains, Bus Trunking and
Overhead Bus bar System

7.1 Scope

This covers supply/ erection/ testing and commissioning of the equipment suitable for 415 Volt, 3 Phase, 50 HZ 4 wire system.

7.2 Requirements

(a) For each equipment, required IP rating and short circuit rating capacity will be specified. Governing BIS/ IEC also will be specified.

(b) All the equipment will be factory fabricated in an approved factory having modern fabrication and testing process. It shall have seven tank pre-treatment process comprising of degreasing, rinsing, derusting, rinsing, phosphatising, rinsing and passivation followed by powder coat painting having a paint thickness of 60 microns or as specified. The powder paint will be subjected to oven-heated process. All panels will be provided with suitable gasket to make it dust/ vermin proof.

7.2.1 Power switchgear and control gear assemblies (PSC-ASSEMBLIES)(LT Panels)

It is combination of one or more low-voltage switching devices together with associated control, measuring, signalling, protective, regulating equipment, with all the internal electrical and mechanical interconnections and structural parts. This clause of specification is applicable to PSCASSEMBLIES for which the rated voltage does not exceed 1 000 V in case of a.c.

(a) This section covers the detail requirements for Design, Manufacturing, Testing and Verification at works of the L.T. Panel made out of CRCA/GI Zinc Coated sheet steel indoor type, floor mounted, free standing, totally enclosed,

extensible type, air insulated type for use on 415 Volts, 3 phase with neutral, 50 cycles/sec system. The LT panel construction performance, testing and verification shall conform to (a) IS/IEC 61439-1: 2011 (Low-Voltage Switchgear and Control gear Assemblies - Part 1 General Rules), b) IS/IEC 61439-2: 2011 (Low-voltage switchgear and control gear assemblies – Part 2: Power switchgear and control gear assemblies).

The equipment shall be designed to conform to the requirements of:

Individual equipment housed in the Main L.T. Panels shall conform to the following IS Specification.

(i) Air circuit breakers/ moulded case circuit breaker IS: 60947 (Part-II) & IEC 60947(2)

(ii) Fuse switch and switch fuse units IS: 13947 (Part-3) & IEC 947 (3).

(iii) HRC fuse links IS: 13703

(iv) Current Transformers IS :2705

(v) Voltage Transformers IS :3156

(vi) Indicating Instruments IS: 1248

(vii) Integrating Instruments IS : 722

(viii) Control Switches & Push Buttons IS : 6875

(ix) Auxiliary Contactors IS: 13947 (Part-4/Sec.-I) & IEC 947 (4/1)

(x) Relays IS: 3231

(b) The panel shall be compartmentalized type having space and arrangement for incoming cable/ bus ducting, incoming switchgear/ switchgears, bus coupler, insulated and properly supported compartmentalized bus bars, outgoing compartmentalized switchgear, bus bar supports, joint shrouds, cable alleys of suitable size for cabling routing, support and terminations, inter-connection between bus bars and switchgear with auxiliary bus bars/ insulated conductors/ strips etc. Also, the panel will be provided with necessary instrumentation like CTs, PTs, Ammeters, Voltmeters, phase indicating lamps, other required instruments, wiring, fuses etc.

(c) It shall be fabricated out of CRCA sheet not less than 2.0 mm thick for load bearing members/ GI 275GSM Zinc coated metal. and 1.6 mm for doors of LT panels. General constructions shall employ the principle of compartmentalization and segregation of each circuit. Unless otherwise approved, incomer and bus section panels shall be separate and independent and shall not be mixed with sections required for feeders. Operating handle of the highest unit shall be at a height not more than 1.7 mt. Overall height of the board shall not exceed 2.3 metre.

(d) Arrangement for Incoming/Outgoing Cable Termination

Cable entries shall be provided either from the rear or from the front through cable alleys of suitable size. Removable gland plate to be provided for each cable entry. Cable support arrangement to be provided inside cable alley so that cables are neatly arranged and fixed. From each outgoing switch, insulated strip/ conductor of suitable size to be provided up to suitable terminal block, which will receive incoming/ outgoing cable termination. It is desirable that cables are not terminated directly to switchgear, but terminated through proper terminal blocks.

(e) Specification of Cable Terminal Block

Terminal block of reputed make shall be used. The housing material shall be polyamide having unbreakable and fire-retardant characteristic. All the metal parts shall be made up of copper alloy including the screws. Mounting shall be 'Din' or 'G-rail' type. Screws shall be self-captive type. No protection cover is required, and the block should be touch proof.

(f) Bus bars/ Supports/ Clearances

The bus bar system may comprise of a system of main/ auxiliary bus bars run in bus bar alleys. For bus bar material, ratings, current density, insulation, supports, bus bar clearances and joints see para 7.2 (iii).

(g) Earthing

Protective earthing conductor shall be sized according to Table F-5 of Chapter- 17- Appendix F and shall conform to IS/IEC 61439-1 : 2011 and IS/IEC 61439-2 : 2011. Earth busbars shall be fixed in the panel connected to incoming protective earth conductors. 2 no's of busbar and connections are recommended.

(Layout of Electrical Panel is explained in Chapter -19 Fig. 7)

(h) Commissioning

After erection, the LT panel will be commissioned after:

- Tightening of all nuts and bolts.
- Closing any left-out holes to ensure the entire panel is insect proof.
- Megger testing.
- Earth testing.

(i) The enclosures shall be designed to take care of normal stress as well as abnormal electromechanical stress due to short circuit conditions. All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP 42 unless otherwise stated.

Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 42 is retained. Suitable pressure relief devices shall be provided to minimize danger to operator during internal fault conditions. The design should have undergone Internal Arc tests for different types of feeders.

(j) For operator safety IP2 X (touch proof) protection to be available even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / Hylem sheets shall not be allowed.

(k) Switchboard shall have finger touch proof design with rear Terminals for MCCB feeders. Rear stud terminals shall be used directly on MCCB to avoid any direct touch in the front.

7.2.2 Switchboard Configuration

(a) The Switchboard shall be configured with Air Circuit Breakers, MCCB's, MPCB, MCB's and other equipment as called for in the schedule of quantities.

(b) The MCCBs shall be arranged in multi-tier formation. The incoming Air Circuit Breakers shall be arranged in Single tier formation only but Double tier formation to facilitate operation and maintenance may be used for outgoing air circuit breakers only.

(c) The Switchboards shall be of adequate size with a provision of spare space to accommodate possible future additional switch gear.

7.2.3 Constructional Features

(a) The Switchboards shall be metal clad totally enclosed, floor mounted free standing type of modular bolted type extensible design suitable for indoor mounting. Switchboard shall have a double front door arrangement to avoid unauthorized access. Suitable locking arrangement has to be considered.

(b) Switchboards construction shall employ the principle of compactization and segregation for each circuit.

(c) Incomer and bus section panels or sections shall be separate and independent and shall not be wired with sections required for feeder. The incomer panel shall be suitable for receiving bus trunking or MV cable of size specified.

(d) Switchboards shall be made up of requisite vertical sections, which when coupled together, shall form continuous dead front switchboards.

(e) Switchboard shall be readily extensible on both sides by addition of vertical sections after removal of the end covers.

(f) The switchboards shall be designed for use in high ambient temperature and humid tropical conditions as specified. Ease of inspections, cleaning and repairs while maintaining continuity of operation shall be provided in the design.

(g) Metal based Polyurethane gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide required degree of protection as stipulated in schedule of quantities. The unused openings within the switchboards shall be closed using suitable grommets.

(h) Special care to be taken to ensure effective earthing of the frame and doors of the switchboards.

(i) Each vertical section shall be provided with a rear or side cable chamber housing the cable end connections and power/control cable terminations. There should be generous availability of space for ease of installation and maintenance with adequate safety for working in one vertical section without coming into contact with any live parts. The design of the switchboard shall allow standard extension chambers if required to accommodate cables.

(j) Switchboard panels and cubicles shall be fabricated with CRCA/GI Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be fabricated from CRCA sheet steel of thickness as per manufacturer standard. Joints of any kind in sheet metal shall be bolted construction.

(k) All panels and covers shall be properly fitted. The holes in the panel shall be correctly positioned.

(l) Switchboard shall be provided with "Danger Notice Plate" conforming to relevant Indian Standards.

(m) Panel shall be tested for Seismic withstand of Zone-IV as per IEEE/IEC/BIS.

(n) All panels shall have facility for providing tubing for gas flooding system. The gas flooding shall be provided by the Panel Manufacturer / third party, as specified in the tender, just before the commissioning of the Panel. These Gas flooding system shall also be connected to the FAS through a monitor module

7.2.4 Switchboard Dimensional Limitations

(a) The overall height of the switchboard shall be limited to 2450 mm or less as per manufacturer's standards for all the Bus bar ratings and type of switchboards.

(b) The height of the operating handle, push buttons etc shall be restricted between 300 mm and 1800 mm from finished floor level.

(c) Other dimensional limits if any are specified separately.

7.2.5 Switchboard Compartmentalization

(a) For compartmentalized switchboards, separate totally enclosed compartments shall be provided for horizontal busbars, vertical busbars, ACBs, MCCBs, and cable alleys.

(b) All feeders having ACB & MCCB shall have rear or front terminal cable connection as specified in the tender / as per requirements of site.

(c) The main board shall be with Form 4b Construction. Form 4b Construction has provisions for Separation of busbars from all functional units, Separation of all functional units from one another, Separation of terminals for external conductors associated with a functional unit from the terminals of any other functional unit and the bus bars, Separation of the external conductors from the busbars, Separation of the external conductors associated with a functional unit from other functional units and their terminals, External conductors need not be separated from each other and Terminals not in same compartment as associated functional unit as per IEC 61439-2.

(d) Earthed metal or insulated shutters shall be provided between draw out and fixed portion of the switchgear such that no live parts are accessible with equipment drawn out. Degree of protection within compartments shall be at least IP 2X.

(e) Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "ON" and "OFF" position.

(f) For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.

(g) Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating and duty. All operating device shall be located in front of switchgear only.

(h) A suitable wire way with cover shall be provided to take interconnecting control wiring between vertical sections.

(i) Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top. The construction shall include necessary and adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley / cable chamber.

7.2.6 Switchboard Bus Bars

(a) Busbars shall be made of high conductivity, 99.9% purity, high strength Aluminium of ETP grade Busbars shall be of rectangular cross sections, suitable for 1.25 times full load current for phase and Neutral bus bar or as stipulated in schedule of quantities. Busbar shall be suitable to withstand the stresses of fault level as specified in schedule of quantities.

(b) The bus bar system may comprise of a system of main horizontal bus bars and auxiliary vertical bus bars run in bus bar alley on either side in which the circuit could be arranged with front access for cable entrances.

(c) The bus bars shall be supported on non-breakable, non-hygroscopic epoxy resin or glass fiber reinforced polymer insulated supports able to withstand operating temperature of 110°C at regular intervals, to withstand the forces arising from a fault level as stipulated in schedule of quantities. The material and the spacing of the Busbar supports should be same as per the type tested assembly & supplied by OEM with valid test reports.

(d) Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequately supported and sized to suit specific requirement. The material for auxiliary supply bus will be insulated electrolytic copper.

(e) Clearances

The minimum clearances to be maintained for enclosed indoor air insulated bus bars for medium voltage applications shall be as per IEC guidelines

7.2.7 Switchboard Interconnection

(a) All connection and tap offs shall be through adequately sized connectors appropriate for fault level at location. This shall include tap off to feeders and instrument/control transformers.

(b) For unit ratings up to 100 amps, PVC insulated 105 deg withstand, copper conductor wires of adequate size to carry full load current shall be used. The terminations of such interconnections shall be crimped. Solid connections shall be used for all rating of above 100 amps.

(c) All connections, tapings, clamping, shall be made in an approved manner to ensure minimum contact resistance. All connections shall be firmly bolted and clamp with even tension. Before assembly joint surfaces shall be filed or finished to remove burrs, dents and oxides and silvered to maintain good continuity at all joints. All screws, bolts, washers shall be zinc plated. Suitable grade nuts and bolts shall be used for busbar connections.

7.2.8 Draw out Features

Air Circuit Breakers shall be provided in fully draw out cubicles, unless otherwise stated. These cubicles shall be such that draw out is possible without disconnection of the wires and cables. The power and control circuits shall have self-aligning and self-isolating contacts. Mechanical latches shall be integrated in ACB at service, test and isolated position to ensure that Breaker is firmly latched in respective position. It shall not be possible to move the breaker from the position unless latch is manually operated.

7.2.9 Instrument Accommodation

(a) All voltmeter and ammeter and other instruments shall be flushed mounted type of size 96sq.mm conforming to class 1.0 or as specified to IS 1248 for accuracy.

(b) Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switchboard.

(c) For MCCBs, instruments and indicating lamps can be provided on the compartment doors.

(d) The current transformers for metering and for protection shall be mounted on the solid copper/aluminium busbars with proper supports.

7.2.10 Wiring

All wiring for relays and meters shall be with PVC insulated copper conductor FRLS wires. The wiring shall be coded and labeled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 sq. mm. Runs of wires shall be neatly bunched and suitably supported and clamped. Means shall be provided for easy identification of wires. Identification ferrules shall use at both end of wires. All control wires meant for external connections are to be brought out on a terminal board. The cables and control wires shall be suitable for withstanding 105 deg C.

7.2.11 Space Heaters

Anti- condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 50°C. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the switchboard is in operation. As a general rule, the heaters shall be placed at the bottom of the cubicle.

7.2.12 Earthing

Continuous earth bus sized for prospective fault current to be provided with arrangement for connecting to station earth at two points. Hinged doors / frames to be connected to earth through adequately sized flexible braids.

7.2.13 Sheet Steel Treatment and Painting

Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognized phosphating process after which a coat of primer paint compactively with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50 micron thickness, of sheet approved by Engineer-in-Charge shall then be provided.

7.2.14 Name Plates and Labels

Suitable engraved white on black name plates and identification labels of metal for all Switchboards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

7.2.15 Design Verification :

7.2.15.1 Routine verification:

Routine verification is intended to detect faults in materials and workmanship and to ascertain proper functioning of the manufactured ASSEMBLY. It is made on each ASSEMBLY. Routine verification shall be as per IEC 61439 I & II. Copies of the routine test certificates shall be submitted by successful tenderers.

The routine verification test are as given below:

(i) Construction

(a) degree of protection of enclosures;

- (b) clearances and creepage distances;
- (c) protection against electric shock and integrity of protective circuits;
- (d) incorporation of built-in components;
- (e) internal electrical circuits and connections;
- (f) terminals for external conductors;
- (g) mechanical operation.
- (ii) Performance
- (a) dielectric properties;
- (b) Wiring, operational performance and function.

7.2.15.2 Design verification :

Design verification and type testing shall be as per IEC 61439-1 and IEC 61439-2. The major parameters/test for design verification are mentioned in Appendix –I-2

7.2.15.3 General Tests:

- (a) A general visual check shall be carried out. This shall cover measurement of over all dimension, location, number and type of devices, terminal boxes, location and connection of terminals etc.
- (b) Checking of bill of materials as per approved drawing.
- (c) Checking of operation of various feeders as per approved schematic drawings.
- (d) Operation check shall be carried out for every control function as per schematic drawings by manually simulating fault conditions and operation of control switches/relays etc.
- (e) Checking of interchange-ability of identical feeders.

7.2.16 **Power and control switchgear assembly/ LT Panels shall be ready to communicate for electrical distribution control system with cloud computing platform as per following :**

LT Panels having Incomer of 630A or higher shall be ready to communicate with a cloud computing platform architecture able to satisfy supervision of electrical system and performance, analysis of relevant data and optimization of installation, control and implementation of energy management strategy.

The system must be scalable, shall be able to collect data from main electrical LV components installed in main and sub-distribution switchboards, and shall establish cloud connection.

Web clients can access to dashboard and data on web, where is possible to configure the system and customize reports and alarms. These panels shall be hooked up with the BMS, if provided.

All native device types have been factory-tested and proven to perform. The Software Platform shall be certified as part of an Energy Data Management System according to the sections of the following ISO standards:

- (a) ISO 50001 : Energy review, Energy baseline, Energy performance indicators, and analysis Input to management review
- (b) ISO 50002: Data collection, Measurement plan Analysis, Energy audit reporting
- (c) ISO 50006: Obtain relevant energy performance information from the energy review Identify energy performance indicators

The Software Platform shall be certified to comply with cybersecurity standard IEC62443 at the component level: IEC62443-4-1 and IEC62443-4-2 (SLI).

The Software Platform shall be designed to streamline the process of checking and maintaining EN50160, IEC61000-2-4 and IEEE 519 Power Quality compliance. The Software Platform shall natively support the vendor's continuous electrical thermal monitoring system with the ability to detect abnormal bus bar or cable temperatures due to loose or faulty connections and to prevent equipment damage and fire. 7. The Software Platform shall be designed to integrate and embed within the vendor's Building Management System (BMS) software platform to provide Energy and Power Management applications within the context of the BMS environment.

7.2.17 **Electrical Standards**

Components shall be compliant to latest versions of following standards and regulations:

- IEC 60947-1 “Low-voltage switchgear and control gear – Part 1: General rules”
- IEC 60947-2 “Low-voltage switchgear and control gear – Part 2: Circuit-breakers”
- IEC61131-3 “Programmable controllers – Part 3: Programming languages”
- IEC 60870-5-104 “Telecontrol equipment and systems – Part 5-104: Transmission
- protocols – Network access for IEC 60870-5-101 using standard transport profiles” EC directives:
- “Low voltage Equipment” No. 2006/95/EC
- “Electromagnetic compatibility Directive” (EMC) No.2004/108/EC

7.2.18 **Environmental characteristics**

Temperature:

- Operating temperature: -25 °C ...+70 °C
- Storage temperature: -40 °C... +70 °C

7.2.19 **Environmental parameters:**

device shall comply with IEC60721-3-6 (class 6C3) and IEC60721-3-2 (class 3C2).

Pollution degree: device shall be used in environments type PD3

Vibrations: device shall comply with IEC60068-2-6 (1 mm displacement 1-13Hz, 13-100 Hz with acceleration = 0.7 g).

7.2.20 **Functional characteristics**

Supervision system shall be able to collect data from the field and, through Ethernet bus, store information in one system, accessible via Cloud. Data and parameters measured depend on electrical devices connected, in addition to monitoring of electrical magnitudes; system shall provide status and maintenance indicators, alarms and alerts. Main device of supervision system architecture is a communication module with an integrated software that behave as concentrator and gateway, allowing management of parts of electrical system located in different areas directly from web application.

7.2.21 **Scalability**

It shall be possible to design different architecture sizes, with adoption of one single communication module or it shall be possible to integrate more communication modules to supervise one electrical installation, according to number of devices interconnected and functionalities required. System shall have high degree of flexibility enabling the integration on electrical systems already installed with limited impact on existing architecture. System scalability shall ensure integration of new devices without requiring re-programming or re-configuration of the connected system.

7.2.22 Electrical Devices

It shall be possible to connect supervision system to electrical devices provided with communication protocols supported. It shall be possible to interconnect to cloud supervision system devices of type specified below:

- Air circuit breakers
- Moulded Case circuit breaker
- Metering devices
- Metering and monitoring device system for miniature circuit breaker
- Fuse gear
- Digital Meters / sensors
- Arc flash protection system

7.2.23 Communication

Protection and metering devices shall be provided with standard communication protocols Modbus TCP/IP. Main communication module shall work as interface between electrical devices and cloud and shall be provided with Ethernet gate. System shall provide automatic monitoring of communication, and alerts shall be notified in case of communication problems.

7.2.24 Data storage and notifications

Supervision system shall have a data logging interval of 30 seconds to ensure a fast reaction in case of warning or alerts and a continuous measure for reliable efficiency analysis. Supervision system shall be designed to monitor following data, without storage limitation Capability Consumption measures:

- Real time phase currents
- Voltages
- Active Power
- Reactive Power
- Apparent Power
- Active Energy
- Reactive Energy
- Apparent Energy
- Power Factor
- Peak active Power

Quality data

- THD
- Total reactive Power
- Voltage Unbalance
- Voltage Spike
- Voltage micro-interruption
- Voltage short Sage
- Voltage middle Sag
- Voltage long Sag
- Voltage short Swell
- Voltage Long Swell

Maintenance data

- Contact wear
- Number of trips
- Total operations
- Manual operations

It shall be possible to monitor status of devices and alarms. It shall be possible for web user to set up to 23 different alerts, identifying alerts for specific devices or on all devices, in order to schedule maintenance and to check health of installation.

Alerts shall include:

- Phase and neutral currents
- Phase to phase and phase to neutral voltages
- Total active power
- Total reactive power
- Total apparent power
- Power factor
- Number of operations
- Contacts wear
- Trip coil disconnected
- Over temperature
- Motor operator over temperature
- Circuit breakers trip
- Any trip
- Status Open/ close

It shall be possible to set alarms and define type of notification through SMS or e-mail for each user.

7.2.25 Analytics and reports

Supervision system shall be provided with web app with preconfigured widget to allow immediate overlook of plant consumption and analytics based on collection of data on selectable period of one day, one week, one month, one semester, one year or on custom period. Widget should be designed to display single or multi-site information and shall include both power utility consumption and power generated on site.

Web app shall allow the creation and customization of “digital” representation of asset, allowing creation of synoptic representation of switchboard, importation of single line diagram or switchboards’ front view. It shall be possible to activate the graphics by connection with markers or tags, to easily access to device data. Export of data and trends in excel shall be possible both ondemand and via automatic report scheduling function. It shall be possible to generate reports for all information managed or generate customize reports selecting specific measures and devices. Benchmark on multi-site level shall also be possible to compare plants and systems and identify best practices.

7.2.26 Commissioning and maintenance

System shall allow final user or panel builder to execute the commissioning with the simple use of free software provided by manufacturer. Automatic recognition of devices shall be ensured so that there are no needs of programming and free software shall include wizard for commissioning directly from web. Free software provided by manufacturer shall allow execution of system implementation without requiring system integrator.

7.2.27 Interface

System shall be supplied with pre-set graphic pages with dashboard for immediate evaluation and management of power consumption. It shall be possible to display dashboard on tablet or smartphone.

7.2.28 Security

Authentication system shall be provided to access to data. Encrypted communication channel and certification for communication to cloud and from cloud to web app shall be guaranteed. Encrypted communication channel and certification shall follow TLS protocol to ensure maximum safety level available. TLS protocol shall be provided embedded in the module for supervision and cloud connection.

7.2.29 Level of users

It shall be possible to define at least 4 different profiles for users. Only one of the users can be identified as owner. The owner shall sign up the EULA to start the data transmission and has the rights to renew license of use. Only owner and administrator can send invitation to other users and have rights to change roles. It shall be possible to define staff profile with the rights to access to asset and device view, alerts view, analytics view and control view. It shall be possible to assign visitor profile for enabling users to access only to alerts view.

7.2.30 License and firmware update

Transmission and access to data and analytics is set per license. License shall include automatic firmware upgrade and maintenance with life time free provisions.

7.2.31 The Specification of power and switchgear assembly (LT Panel) shall be defined by NIT authority as mentioned in Appendix I.1

7.3 Rising Mains

7.3.2 Application

(a) The rising mains are essentially used in electrical distribution system in building 2 storied and above. These are only for indoor applications. For vertical power distribution, this is a preferred method, compared to rising cable system and is more reliable and safer from point of view of fire hazard.

(b) Tap-off arrangements shall be provided on the rising mains with tap-off boxes.

(c) The rising main shall comprise of sheet metal enclosure, bus bars, tap-off points, tap-off boxes, end feed units, fire barriers, expansion joints, thrust pads, end covers and fixing brackets etc.

(d) The rising main shall conform to IS/IEC 61439-1 2011 and IS/ IS/IEC 61439 : Part 6 : 2012 and shall be suitable for 415 V, 3 phase, 50 Hz supply and insulation of rising mains shall be capable of withstanding the voltage of 660-volt AC. Degree of IP protection and short circuit rating shall be specified.

7.3.3 Enclosure

The enclosure shall be made from sheet steel/ALLUMINIUM of minimum 1.6 mm thickness and IK 08.

7.3.4 Bus bars

(a) Rating

Bus bars shall be made of wrought aluminium or aluminium alloy, or electric grade copper, conforming to relevant Indian Standard, as specified. The ratings of the bus bars shall be 100A, 200A, 300A, 400A, 500A, 600A, or 800A as specified.

(b) Current Density

Bus bars shall be of sufficient cross-section so that a current density of 130A/ sq.cm (800A/sq. Inch) is not exceeded at nominal current rating for aluminium bus bars, and 160A/sq.cm (1000A/sq. Inch) for copper bus bars. The minimum sizes of sections of bus bars are given in Table 7.1 below.

(c) Cross Section of Bus Bars

The cross section of the neutral bus bar shall be the same as that of the phase bus bar for bus bars of capacities up to 200A; for higher capacities, the neutral bus bar must not be less than half the crosssection of that of the phase bus bar.

(d) Insulation

Each bus bar shall be suitably insulated with Class B/Class F Insulation.

The insulation of the rising mains shall be capable of withstanding the voltage of 660 V of AC.

(e) Bus Bar Supports

Bus bar support insulators shall be class F insulators made of non- hygroscopic, non-combustible, track resistant and high strength FRP/ SMC/ DMC material, and shall be of suitable size and spacing to with-stand the dynamic stresses due to short circuit currents. The spacing between two insulators should be provided by the manufacturers according to the design approved by CPRI for their bus bar supports.

(f) Bus Bar Clearances

(i) The minimum clearance to be maintained for enclosed indoor air insulated bus bars for medium voltage applications shall be as follows:

Between Min. Clearances

Phase to earth 26 mm

Phase to phase 32 mm

Note: For strip connection from bus bars to switchgear, the above clearances don't apply.

(ii) (a) Bus bar joints shall be thoroughly cleaned and a suitable oxidizing grease shall be applied before making the joint.

(b) High tensile bolts, plain and spring washers shall be provided to ensure good contact at the joints.

(c) The overlap of the bus bars at the joints shall be not less than the area of the cross section of the bus bars.

(g) Bus Bar Marking

Bus bars and main connections shall be marked by colour or letter as per Table 7.2.

7.3.5 Expansion Joint

Expansion joint made of aluminium/copper strips shall be provided wherever necessary, to take care of expansion and contraction of the bus bars under normal operating conditions. This shall be invariably provided whenever the length of the rising mains exceeds 15 m.

7.3.6 Thrust Pads

(a) The bus bars shall be provided with thrust pads so that the expansion of the conductors is upwards only.

(b) The bus bar clamps and insulators shall be designed to withstand the forces due to short circuit current. They shall also permit free vertical movement of the bus bars during expansion and contraction.

7.3.7 Mounting

(a) Incoming cable will be connected to the rising main through an end feed unit, consisting of switch fuse unit with MCCB/ ACB of required capacity and cable end box.

(b) Tap-off boxes at specified intervals and height shall be provided on rising main to tap power. The box shall consist of set of MCCB/ Switch fuse unit, so that power from rising main can be switched ON/OFF and provided with suitable overload/ short circuit protection.

(c) Distribution boards/ switch boards will not be mounted on rising main. Such boards will be separately erected on floor/ wall and connected to tap-off box with suitable copper conductor cable (See Fig. 9).

7.3.8 Construction Features

(a) The rising mains shall be manufactured in convenient sections to facilitate easy transportation and installation. The sections shall be connected to form a vertical run at site. Each section shall be provided with suitable wall straps at convenient intervals for fixing to the wall.

(b) The enclosure shall be sturdy so as to withstand the internal and external forces resulting from the various operating conditions.

(c) The front covers shall be detachable. Neoprene gaskets shall be provided between the covers and the side channels.

(d) The enclosure shall have a degree of protection not less than IP 42.

(e) The rising main shall be designed for temperature rise not exceeding 40 degrees Cover ambient temperature of 45-degree C.

(f) Built-in fireproof barriers having 2 hr. fire rating shall be provided to restrict the spread of fire through the rising mains from one section to the adjacent section.

(g) Necessary provisions for ventilation shall be made at suitable intervals. These shall be complete with welded non-ferrous metallic mesh to prevent entry of vermin.

(h) Where the installation contains equipment having metal enclosures such as low-voltage switchgear and controlgear assemblies (see IS/IEC 61439-1 and IS/IEC 61439-2) or busbar trunking systems (IS/ IEC 60439-6), their. The metal enclosures or frames of Bus Trunking may be used as protective conductors if they simultaneously satisfy the following three requirements:

a) Their electrical continuity shall be assured by construction or by suitable connection so as to ensure protection against mechanical, chemical or electrochemical deterioration;

b) The cross-sectional area of every protective conductor shall satisfy the conditions for automatic disconnection of supply required in Table F-5 and be capable of withstanding mechanical and thermal stresses caused by the prospective fault current during the disconnection time of the protective device;

c) they shall permit the connection of other protective conductors at every predetermined tap-off point.

(i) In case provision of 7.3.7(h) above could not be complied than Two numbers of copper earth strips of appropriate size shall be provided alongside the bus trunking enclosure and shall be bolted with each section of the bus trunking (Table 7.3).

7.3.9 Installation of Rising Mains

(a) Rising mains shall be installed on walls, to which the foundation bolts shall be suitably grouted (in a shaft of adequate size for rising main and floor distribution panel). The foundation bolts shall be provided by the contractor without extra payment.

(b) (i) No structural member in the building shall be damaged/ altered, without prior approval from the competent authority through the Engineer-in- charge.

(ii) Structural provisions like openings, cut-outs, if any, provided by the department for the work, shall be used. Where these require modifications, or where fresh provisions are required to be made, such contingent works shall be carried out by the contractor at his cost.

(iii) All such openings in floors provided by the Department shall be closed by the contractor after installing the cables/ conduits/ rising mains etc. as the case may be, by any suitable means as approved by the Engineer-in-charge without any extra payment.

(iv) All chases required in connection with the electrical works shall be provided and filled by the contractor at his own cost to the original architectural finish of the buildings.

7.3.10 Commissioning

Before connecting mains supply after installation, pre-commissioning checks comprising megger test, checking the tightness of connections, body earth connection etc. shall be carried out and recorded.

7.4 Bus Trunking

7.4.2 Application

These are generally provided for interconnections between the transformers of 400 KVA and above and DG sets of 300 KVA and above and their switch board panels, and also for interconnections between large switch board panels where specified, thereby avoiding use of large sizes of cables for such interconnections. brackets etc.

The Bus Trunking shall conform to IS/IEC 61439-1 2011 and IS/ IS/IEC 61439 : Part 6 : 2012 and shall be suitable for 415 V, 3 phase, 50 Hz supply and insulation of rising mains shall be capable of withstanding the voltage of 660-volt AC. Degree of IP protection and short circuit rating shall be specified.

7.4.3 Materials

7.4.3.1 Enclosure

Sheet steel of minimum 2 mm thickness/ ALLUMINIUM of minimum 1.6 mm thickness and IK 08 shall be used for fabricating the enclosure.

7.4.3.2 Bus Bars and Supports

Bus bars and their supports shall comply with clauses 7.3.3 of these specifications. The current rating shall be as specified in individual cases.

7.4.4 Construction

7.4.4.1 Enclosure

(a) The enclosure shall be of bolted type, box type, welded type or any other type as per the manufacturer's standard practice, and shall be made out from sheet steel of minimum 2 mm thickness/ ALLUMINIUM of minimum 1.6 mm thickness and IK 08.. The front cover only shall be detachable. The section of the bus duct shall be rectangular. The enclosure shall be sturdy so as to withstand the internal and external forces resulting from the various operating conditions.

(b) The bus trunking enclosure shall be fabricated in convenient sections for easy transportation and installation. The sections shall be connected to form horizontal and vertical runs as required at site. The enclosure shall be provided with flanged ends with drilling arrangements to suit the flanges at the switchgear and transformer terminals. All flanges shall be provided with gaskets, nuts, bolts, washers etc.

(c) The entire bus trunking enclosure shall be designed for dust and vermin proof construction. The enclosure for outdoor installation shall be additionally in weatherproof construction. The enclosure shall have a degree of protection not less than IP 42 for indoor application, and IP 54 for outdoor application in accordance with IS 2147.

(d) Bus trunking, if required to be installed outdoors, shall be provided with a metallic protecting canopy of adequate size above the bus trunking, fabricated as part of the enclosure.

(e) Neoprene gaskets shall be provided to satisfy the operating conditions imposed by temperature, weather etc. and durability.

(f) Provisions for ventilation shall be made as per clause 7.3.3 of these specifications.

(g) Where the installation contains equipment having metal enclosures such as low-voltage switchgear and control gear assemblies (see IS/IEC 61439-1 and IS/IEC 61439-2) or busbar trunking systems (IS/ IEC 60439-6), their. The metal enclosures or frames of Bus Trunking may be used as protective conductors if they simultaneously satisfy the following three requirements:

(i) Their electrical continuity shall be assured by construction or by suitable connection so as to ensure protection against mechanical, chemical or electrochemical deterioration;

(ii) The cross-sectional area of every protective conductor shall satisfy the conditions for automatic disconnection of supply required in Table F-5 and be capable of withstanding mechanical and thermal stresses caused by the prospective fault current during the disconnection time of the protective device;

(iii) They shall permit the connection of other protective conductors at every predetermined tap-off point.

(h) In case provision of 7.4.3.1(g) above could not be complied than Two numbers of copper earth strips of appropriate size shall be provided alongside the bus trunking enclosure and shall be bolted with each section of the bus trunking (Table 7.3).

7.4.4.2 Expansion Joint/ Flexible Termination

(a) Flexible connections shall be provided by braided or multi-leafed conductors for terminations at transformer bushing and switchgear.

(b) Expansion joints shall be provided as per clause 7.3.4 of these specifications.

7.4.5 Installation

(a) Each section of the enclosure shall be suspended from the ceiling slab with suitable MS suspenders and support angles/ channels. The runs shall be neat and the route shall be as directed by the Engineer-in-charge.

(b) The bus trunking shall be supported such that its weight does not come on the terminations.

(c) Danger notice boards shall be provided on the bus trunking enclosure at suitable intervals in every room through which it passes.

(d) The earthing strips shall be properly terminated to the earth bars at both ends.

(e) Pre-commissioning checks shall be conducted.

7.5 Overhead Bus Bar System

7.5.2 Application

The overhead bus bar system is generally used for distribution of power to a number of distributed power loads, such as motors, as in a workshop. This system has an in-built flexibility for meeting additional loads without much change in the distribution system. These specifications cover indoor application only.

7.5.3 Materials

7.5.3.1 Enclosure

Sheet metal used for fabrication of side channels shall be 1.6 mm thick and the top and bottom covers 1.2 mm thick.

7.5.3.2 Bus Bars and Supports

- (a) The bus bars shall comply with clause 7.3.3 of these specifications. The bus bars shall however be rated for 200A, 300A or 400A as specified. Each bus bar shall be individually insulated by means of PVC sleeves.
- (b) The bus bar supports shall comply with clause 7.3.3 (e) of these specifications.

7.5.4 Construction

- (a) The enclosure shall be sturdy to withstand the internal and external forces resulting from the various operating conditions. The enclosure shall have a degree of protection not less than IP 54 for indoor application and IP 65 with Canopy for outdoor application in accordance with IS 2147.
- (b) The top and bottom cover plates shall be detachable, and shall complete with gaskets to make the enclosure totally dust and vermin proof.
- (c) The enclosure shall be fabricated in convenient sections for easy transportation and installation. The bus sections shall be jointed together with flanges and tie bolts. Each section of the enclosure shall be suspended from the ceiling slab with suitable and rigid MS suspenders and brackets as required.

Detachable blank sheet steel covers shall be provided for enclosing the free ends of the bus bar run.

7.5.5 Plug-in Boxes

- (i) Each section of the bus bar enclosure shall have plug-in points spaced at intervals of approximately 600 mm for the insertion of plug-in boxes.
- (ii) The plug-in boxes shall be fabricated as compact sheet steel boxes with hinged doors and shall house the fuse holders/ MCCB/ MCB. The fuse holders/ MCCB/ MCB shall be solidly connected to high conductivity copper clip-on contacts and reinforced by spring steel strips. These clip-on contacts shall plug-in directly on to the bus bars at the plug-in points.
- (iii) Two earth points shall be located at the ends of the plug-in boxes. While inserting these boxes into the plug-in points, the earth points shall engage first in the special earth bushes provided on the underside of the bus bar enclosure before the main contacts are made. While withdrawing these boxes, the earth contact is maintained even after the main contacts are isolated.
- (iv) The plug-in boxes after insertion into the plug-in points shall be fastened by wing nuts.
- (v) Each plug-in box shall be fitted with a brass compression gland suitable for the size of the cable specified. It should be possible to provide this gland in any position, i.e. left hand side, right hand side or lower side of the plug-in box.
- (vi) The unused plug-in points shall be blanked with detachable sheet steel covers.
- (vii) All contacts on joint and plug-in opening shall be silver/Tin plated copper.
- (viii) On plug-in busbar trunking there shall plug in points at required locations to meet the site requirement. This plug-in point shall have a hinged insulated click fit cover.
- (ix) All openings shall be usable simultaneously.

7.5.6 Installation

- (a) The bus sections shall be jointed together with flanges and tie bolts. Each section of the enclosure shall be suspended from the ceiling slab with suitable MS suspenders and support angles/ channels as required.
- (b) Bus trunking shall be suspended at a uniform height of minimum 2.4 m above floor level. The layout shall be got approved from the Engineer-in-charge before erection.
- (c) The runs shall be straight, except at points of changes in direction.
- (d) A connector assembly shall be supplied loose with each section of the enclosure for coupling two sections, and it shall comprise a rubber locating ring, bus bar insulating tube and a connector insulating tube.

7.5.7 Earthing

- (a) Where the installation contains equipment having metal enclosures such as low-voltage switchgear and controlgear assemblies (see IS/IEC 61439-1 and IS/IEC 61439-2) or busbar trunking systems (IS/ IEC 60439-6), their. The metal enclosures or frames of Bus Trunking may be used as protective conductors if they simultaneously satisfy the following three requirements:

- (i) Their electrical continuity shall be assured by construction or by suitable connection so as to ensure protection against mechanical, chemical or electrochemical deterioration;
 - (ii) The cross-sectional area of every protective conductor shall satisfy the conditions for automatic disconnection of supply required in Table F-5 and be capable of withstanding mechanical and thermal stresses caused by the prospective fault current during the disconnection time of the protective device;
 - (iii) they shall permit the connection of other protective conductors at every predetermined tap-off point.
- (b) In case provision of 7.5.6 (a) above could not be complied than Two numbers of copper earth strips of appropriate size shall be provided alongside the bus trunking enclosure and shall be bolted with each section of the bus trunking (Table 7.3). The Copper earth strips of the bus duct shall be connected to the earth bus/ earth terminal(s) of the switchboard controlling the bus ducts, by appropriate protective conductors, notwithstanding the connection by the armouring of the feeder cable.

7.5.8 Danger Notice Board

These shall be provided on the enclosure at suitable intervals and not exceeding 5 m.

7.5.9 Pre-commissioning checks shall be conducted.

7.6 The Specification of rising main/bus trunking shall be defined by NIT authority as mentioned in Appendix I.3 and in conformity with IEC 61439-1 and IEC 61439-6.

7.7 Design Verification of rising mains and bus trunking :

7.7.2 Routine verification:

Routine verification is intended to detect faults in materials and workmanship and to ascertain proper functioning of the manufactured ASSEMBLY. It is made on each ASSEMBLY. Routine verification shall be as per IEC 61439-1 & 6 .Copies of the routine test certificates shall be submitted by successful tenderers.

The routine verification test are as given below:

(1) Construction

- (a) degree of protection of enclosures;

- (b) clearances and creepage distances;
- (c) protection against electric shock and integrity of protective circuits;
- (d) incorporation of built-in components;
- (e) internal electrical circuits and connections;
- (f) terminals for external conductors;
- (g) mechanical operation.
- (2) Performance
- (a) dielectric properties;
- (b) wiring, operational performance and function.

7.7.2.1 Design verification

Design verification and type testing shall be as per IEC 61439-1 and IEC 61439-6. The major parameters/test for design verification are mentioned in Appendix –I-4.

TABLE 7.1
Aluminium/ Copper Bus Bar Sections
[Clause 7.3.3 (b)]

Current Ratings in amps. Upto	Recommended Rectangular Cross-section			
	Aluminum		Aluminum	
	No. of Strips/ Phase	Size in mm	No .of Strips/ Phase	Size in mm
100	1	20 x 5	1	20 x 3
200	1	30 x 5	1	25 x 5
300	1	50 x 5	1	40 x 5
400	1	50 x 6	1	50 x 5
500	1	75 x 6	1	60 x 5
600	1	80 x 6	–	–
800	1	100 x 6	–	–
1000	1	100 x 10	–	–
1200	1	125 x 10	–	–
1600	2	100 x 10	–	–
2000	2	125 x 10	–	–
2500	3	125 x 10	–	–

Note:

- (i) In larger bus bars of sizes above 1000 amps, the sections can be accepted in other rectangular cross-sections and numbers also, provided the total cross- sectional area offered is not less than the total cross-sectional area shown in the above table against the respective bus bar rating.
- (ii) With aluminium bus bars, only aluminium wire/ solid bar connections shall be made for incoming/ outgoing mountings on the switchboards.
- (iii) With copper bus bars, only copper wire/ solid bar connections shall be made for incoming/ outgoing mountings on the switchboards.

TABLE 7.2
[Clause 7.3.3 (g)]

(i) Marking for A.C. Bus Bars & Main Connections

	Bus Bar and Main Connections	Colour	Letter/ Symbol
(i)	Three Phase	Red, Yellow, Blue	R.Y.B.
	Two Phase	Red, Blue	R.B.
	Single Phase	Red	R
(ii)	Neutral connection	Black	N
(iii)	Connection to earth	Green	E
(iv)	Phase variable (such as connections to reversible motors)	Grey	Gy.

(ii) For D.C. Bus Bars and Main Connections

	Bus Bar and Main Connections	Colour	Letter/ Symbol
(i)	Positive	Red	R, or plus
(ii)	Negative	Blue	B, or minus
(iii)	Neutral connection	Black	N
(iv)	Connection to earth	Green	E
(v)	Equalizer	Yellow	Y
(vi)	Phase variable (such as connections to reversible motors)	Grey	Gy

Note: In the wiring diagram, positive and negative should be indicated by ‘+’ and ‘-’ respectively.

TABLE 7.3
[Clause 7.4.3.1 (g)]

A: Earth Continuity Strip for Protective Earthing of Sub-Station Equipment

S. No.	Type of Installation	Earth Electrode	Earth Strip from Earth Electrode to Earth Bus and Loop Earthing of Equipment
1.	Indoor sub-station with HT panel, Transformer capacity up to 1600 KVA, LT panel, Generating set.	Copper Plate	25x 5 mm Copper Strip
2.	Indoor sub-station with HT panel, Transformer capacity above 1600 KVA, LT panel, and Generating set.	Copper Plate	32x 5 mm Copper Strip
3.	HT Outdoor sub-station	Copper Plate	25x 5 mm Copper Strip
4.	LT Indoor sub-station with generator	Copper Plate	25x 5 mm Copper Strip
5.	LT switch room having Main LT Switch Board	Copper Plate	20x 3 mm Copper Strip

B: Earth Continuity Strip for Bus Trunking and Rising Main

S. No.	Type of Installation	Material of Main Conductor	Earth Strip
1.	Bus trunking capacity upto 2500 Amp	Copper/ Aluminium	2 Nos. 25x5 mm copper strip
2.	Bus trunking capacity Above 2500 Amp	Copper/ Aluminium	2 Nos. 32x5 mm copper strip
3.	Bus trunking for connecting generating set and LT panel	Copper/ Aluminium	2 Nos. 25x5 mm copper strip
4.	Rising main upto 400 Amp capacity	Copper/ Aluminium	2 Nos. 20x3 mm copper strip
5.	Rising main above 400 Amp and upto 800 Amp capacity	Copper/ Aluminium	2 Nos. 20x5 mm copper strip

C: Neutral Earthing of Transformers and Generators

S. No.	Equipment	Earth Electrode	Earth Strip from Earth Station to Neutral
1.	Transformer of capacity up to 1600 KVA	Copperplate	25x 5 mm Copper strip
2.	Transformer of capacity above 1600 KVA	Copperplate	32x 5 mm Copper strip
3.	Generating set of all capacity	Copperplate	25x 5 mm Copper strip

CHAPTER 8 EARTHING

8.1 Scope

This chapter covers the essential requirements of earthing arrangement and their installation. This shall be read with Appendix F, which lays down criteria for their design. For details not covered in these specifications, IS code of Practice on Earthing (IS 3043: 2018) and NEC 2023 shall be referred to.

8.2 Application

8.2.1 The purpose of earthing in an installation is to provide a low earth fault loop impedance to facilitate automatic disconnection of supply in the event of a fault to exposed conductive parts, and Limit the rise of potential under earth-fault conditions of non-current carrying metal work with respect to earth to increase safety of persons and animals in proximity to such metal work.

8.2.2 Protection against electric shock both in normal service (protection against direct contact) and in case of fault (protection against indirect contact) can be achieved by several measures. The recommended fault protective measure in IS3043 to be applied in solidly earthed system is protection by automatic disconnection of supply.

Protective measure called Automatic disconnection is intended to prevent a touch voltage persisting for such time that a danger could arise. This method necessitates co-ordination of the type of system earthing, and characteristics of protective devices.

Safety against earth fault shall be achieved by implementing appropriate measure as follows:

(a) The electrical distribution system in the Department is with solidly earthed neutral (i.e. neutral is connected to the earthing arrangement). In addition to the neutral earthing, provision is made for earthing the metallic body of equipment and non-current carrying metallic components in the substation, as well as in the internal/ external electrical installations as shown in figure F-13 A to F-13 D and explained in appendix F. Neutral shall be earthed strictly only at one location either at the point of commencement of supply or near the respective source and shall be carried out with a link.

(b) Earthing arrangement consist of a protective equipotential bonding which shall ensure that earth fault loop impedance of each circuit is limited to a value determined by the type and current rating of the protective device used such that, on the occurrence of an earth fault, disconnection of the supply shall occur before the prospective touch voltage reaches a harmful value.

(c) TN-S earthing system shall be followed in installations where the source such as Transformer and DG are a part of the installation and in locations where SOLAR PV or other non-conventional sources of power generation is used.

(d) If TT earthing system is provided by the utility for an LV supply, such installation shall be protected against earth fault or earth leakages by installing an RCD whose rated residual operating current does not exceed 30 milliampere at the origin of installation. Type of RCD shall be selected based on G.2.2.2.

(e) IT earthing systems can be adopted in locations where continuity of supply during the first fault is necessary. Insulation monitoring devices shall be installed in these cases. These locations include operation theatres in hospitals, safety services etc. Refer appendix F for more details.

(f) For existing installations where, other systems are installed or an assessment is not possible, a TN-CS system shall be implemented after careful analysis. To ensure that there shall be a separate Neutral conductor and protective earth conductor from the main DB downstream up to the last socket, making a TN-S system within the building. The minimum insulation resistance required between current carrying conductors to earth is 1 MΩ.

(g) The connecting point of the EV supply equipment shall be protected by a TYPE A RCD having a rated residual operating current not exceeding 30 mA. If the EV supply equipment is equipped with a socket-outlet or vehicle connector, Type B RCD shall be used.

(h) Lightning protection earthing shall be carried out as per Chapter 9.

(I) Functional and equipment safety requirements of earthing

(i) Certain application requires functional earthing, which is made by functional equipotential bonding. This is especially necessary for computer and control systems. Functional equipotential bonding is achieved by interconnecting functional earthing terminals of electronic equipment in different topologies as explained in Chapter 17 – Appendix F.

(ii) All protective and functional earthing conductors should be connected to one single main earthing terminal.

(iii) For buildings with large amount of sensitive and critical electronic installation such as Hospitals and Datacenters, a Mesh Bonding Network shall be adopted as per clause 4.5.4.5 of IS732.

Note: for more information refer ISO/IEC 30129

(J) Earthing requirements are laid down in CENTRAL ELECTRICITY AUTHORITY (MEASURES RELATING TO SAFETY AND ELECTRIC SUPPLY) REGULATIONS 2010, as amended from time to time. These shall be complied with.

(K) Application for Internal E.I.:

(i) Every sub-main will have protective conductor that run along with sub-main wiring. In case of 3- phase sub-main wiring to the final equipment, two protective conductors shall be provided to make connection to protective equipotential bonding.

(ii) Every circuit will have its protective conductor running along with circuit wiring. In case of 3-phase circuit to final equipment, two protective conductors shall be provided.

(iii) Looping of earth is allowed only in case of point wiring for light fittings and sockets. Looping is not allowed for wiring in the final circuits for electronic installations such as computers and equipment with SMPS power supply.

(iv) When 2/3 power outlets are looped to one circuit, earth looping of these outlets is permissible.

8.2 Protective equipotential bonding, Types of Protective conductors, Earth Electrodes & Material

Every installation shall have a protective equipotential bonding. Protective equipotential bonding shall ensure that the fault voltages in the installation are less than the tolerable limit. Buildings with steel in concrete (or using steel columns), also to be included as a part of protective equipotential bonding. For more information refer Chapter 17- Appendix F.

The requirements for earthing arrangements are intended to provide a connection to earth which:

8.2.1 is reliable and suitable for the protective requirements of the installation,

8.2.2 can carry earth fault currents and protective conductor currents to earth without danger from thermal, thermo-mechanical and electromechanical stresses and from electric shock arising from these currents,

8.2.3 if relevant, is also suitable for functional requirements,

8.2.4 is suitable for the foreseeable external influences, for example, mechanical stresses and corrosion. Where the supply to an installation is at high voltage, requirements concerning the earthing arrangements of the high voltage supply and of the low-voltage installation shall also comply with 4.5.2 of IS 732. Power-Frequency Stress Voltages and Power-Frequency Fault Voltage in Low-Voltage System due to a fault in HV system shall conform to Table 4 of IS732.

8.3 Earth fault loop impedance and safety

8.3.1 The earth fault loop impedance has to be low enough to allow adequate earth fault current flow to cause an overcurrent protective device (for example, a fuse or circuit breaker) in the faulty circuit to operate in a sufficiently short time.

8.3.2 Earth fault loop impedance of every circuit shall be calculated during design and measured during installation, immediately after commissioning of transformer and DG.

8.3.3 Earth fault loop impedance of each circuit shall be limited to a value determined by the type and current rating of the protective device used such that, on the occurrence of an earth fault, disconnection of the supply shall occur before the prospective touch voltage reaches a harmful value.

8.3.4 Where multiple sources are used in the same installation (e.g. Transformer and DG with changeover facility), fault loop impedance shall be tested for both the sources and automatic disconnection of supply shall be ensured.

8.3.5 The earth resistance at each electrode shall be measured and recorded for the purpose of periodic verification.

8.3.6 Where the above stated earth fault loop impedance is not achieved, necessary improvement shall be made by additional provisions, such as additional earth fault return paths and protective equipotential bonding as may be directed by the Engineer-in-charge.

8.4 Marking

Different earthing symbols and its applications are included in Appendix F



8.4.1 Protective Earth bars/terminals at all switch boards shall be marked permanently, either as “PE” or symbol 5019.

8.4.2 All connections including the protective bonding connections to Main earthing terminal shall be marked “SAFETY EARTH – DO NOT DISCONNECT”.

8.5 Testing

The integrity of safety by “Protective equipotential Bonding and Automatic Disconnection of supply” is ensured by testing

- Efficiency of Automatic disconnection.
- Main and Supplementary Equipotential Bonding.

Efficiency of Automatic Disconnection of supply is tested by measuring fault loop impedance, calculating fault current and comparing with the disconnection time of the respective protective device. While measuring fault loop impedance, attention is required for the following

- Fault loop impedance shall be measured at the final end of the circuit
- Along with fault loop impedance, short circuit loop impedance for current carrying conductors is also a good practice.
- Verifications recommended in IS732 / NEC (SP30: National Electrical code of India) also shall be carried out as explained in Part-1, section-17.

8.6 Use of Residual Current Devices (RCDs)

An extract on selection and application of RCDs (also known as RCCBs) from IS 12640: 2008 is given at Chapter 17 - Appendix G. Provision of RCD shall be specified in individual cases keeping in view the type, use, importance, system of earthing and nature of electrical installations to be protected by the RCCBs, requirements of the local electric supply company, etc. The sensitivity shall be 30 mA or 300 mA as specified.

General Terms & Conditions

1. It is a two part bid which consists of Technical & Financial bid separately. The applicants must upload the Statutory & Non Statutory documents in the Technical Folder. Technical & Financial quote must not be sent through post / physically. Bhagirathi may physically verify documents if required.
2. The intending bidders are required to quote the rate online only. Financial Bid will contain rate of items only. No other document will be sent in the financial bid (Folder).
3. Price quoted by the bidder should be inclusive of all taxes levies packing, forwarding, transportation and any other incidental charges & FOR Feeder Dairy Berhampore.
4. EMD of successful bidder shall be converted to security deposit. EMD of unsuccessful bidders shall be refunded. EMD shall not carry any interest. The EMD which has been converted to Security Deposit shall be released after 6 month of successful execution of the Contract.
5. Time being the essence of contract, Supply, Installation & Commissioning with all necessary work must be completed within 3 weeks.
6. **The bidder should be experienced State Govt. Licensed Electrical Contractors.**
7. Penal Clause: Liquidated Damage of 0.5% of the total cost shall be charged if there is any delay in supply of goods, installation and commissioning subjected to a maximum of 10% of the total cost and the amount shall be recovered from the bills. If the Milk Union makes alternative arrangements due to negligence of the party, the cost of the consignment arranged from the different source shall be deducted from the party.
8. Force Majeure: For delay in supply of goods for which neither the supplier or the Milk Union is responsible like strikes, lockouts, war, catastrophe shall be termed as “Force Majeure” and penalty clause will not be applicable.

9. 100% payment shall be made through NEFT/RTGS within 45 days after successful completion of the job against submission of 3 (three) copies of Invoice and duly certification by Competent Authority.
10. The Requisitioning Authority will certify the quality of goods received at the store. In case if any consignment is not conforming prescribed specification and quality, penalty shall be imposed and the cost will be deducted from the bill accordingly.
11. In case of any dispute between the Milk Union and the bidder the decision of the Milk Union shall be binding.
12. The Milk Union reserves the right to cancel the Contract if the Supplier fails to supply the goods in due time or compromises with the quality of the goods. On termination of contract the security deposit shall be forfeited.
13. The Milk Union reserves the right to accept or reject any tender/all tenders or to cancel the entire process without assigning any reason thereof.

Sd/-
Managing Director
The Bhagirathi Cooperative
Milk Producers' Union Limited

Copy forwarded to:

1. E-Procurement portal of Govt. of West Bengal (<https://wbtenders.gov.in>)
2. Official Website (www.bhagirathimilk.com)
3. Office Notice Board