SCOPE OF ELECTRICAL WORK

Detailed design engineering complete Electrical and Mechanical Engineering services such as:

1. Power source from CESC Limited/WBSEDCL
2. Electrical Installation (both internal & External)
3. Load Calculation & Substation DESIGN
4. Backup Power source.
5. Fire Alarm, Fire Detection & Fighting System.
6. Vertical Transportation system
7. Heating, ventilation and air conditioning design (HVAC) and other mechanical systems
8. Video Conferencing.
9. Public Address system.
10. Water Supply System.
11. Computer Network including high speed internet service.
12. Mortuary Cooler.
13. Lightning Conductor installation.
14. Solar Water heating system.
15. Telecommunications Service
16. IBMS & IT
17. Electrical land scraping both internal and external installation.

Detailed Scope of Works: The scope of work will include but not necessarily be limited to the following.

1. Power Source from WBSEDCL / CESC & H.T overhead line.

a. The bidders shall investigate the existing electrical service/distribution system and determine whether sufficient capacity is available to accommodate the new loads. The Bidder shall inform the electric utility company of the new service requirements and additional loads. The contractor shall forward copies of all correspondence and minutes of meetings to the Employer with the utility company's representatives to regarding negotiations for new services or making changes to the existing services.

b. For new electrical service, the bidders shall coordinate requirements with the local utility service company (**WBSEDCL / CESC)** after carrying out all the required surveys. Prepare the Engineering designs of the service line in sufficient detail to ensure clarity and understanding by the WBMSC.

c. The detailed designs will, as a minimum, including construction drawings for H.T overhead line & details of H.T cables / A.C.S.R, poles, insulators etc. required ,

detailed cost estimates including supply of materials & erecting and testing of the H.T lines. Service charges etc. necessary calculations to determine and justify the engineering details.

2. Electrical Installation (both internal & external)

a. Preparation of necessary Single line diagram(SLD), Power Distribution etc. of all electrical installation for each floor as well as electrical conduit layout drawing of each room, corridor, verandas etc. as per requirement of the Super Specialty Hospital as per MCI norms.

b. Submit Detailed Project Report including preliminary drawings to the WBMSC in respect of internal & external electrification considering all electrical requirements of all electrical loads such as luminaries , fans , electrically operated Medical equipments & instruments required for the hospital, different types of O.T, lifts , HVAC, Generator etc. with distribution panels, distribution boxes showing their actual positions in drawings for incorporating suggested changes, additions and alterations and secure approval of the WBMSC.

3. Load Calculation including loads of Medical equipment for preparation of Substation Design.

a. Calculating electrical loads of all items such as luminaries ,fans ,compound lights, lifts, HVAC, water supply system etc. and medical equipments and detailed design of substation incl. Transformer H.T & L.T gear, L.T panel Earthing etc. and details drawing showing actual position of different items earth pits etc. in the drawings. A preliminary load calculation of both 5 storied building and 10 storied are incorporated in this concept design of Substation according to the approved area of super Specialist Hospital.

4. Backup Power source & uninterrupted power source.

a. To calculate the electrical loads to be supplied from Acoustic control Diesel generator & loads to be supplied from UPS and submit detailed design and drawings of supply & installation of silent generator and UPS to facilitate the works of super specialty Hospital. A preliminary load calculation of both 5 storied building and 10 storied are incorporated in this concept design of Generator.

5. Fire Detection, Fire Alarm & Fighting System.

a. To submit Detailed design & drawings of fire detection, fire alarm & fighting system. The design and installation of a hydraulically calculated automatic wet riser and hydrant system to complete and ready for operation for all portions of Building. The microprocessor controlling system with Zonal controlling arrangement floor vise of the total system are to be ensured. Auto start fire hydrant pumps and jockey pump etc as required are to be designed. SLD of the total distribution system of Fire alarm, intelligent fire &smoke detection, public address system, control wiring etc shall be required. The drawing and design for actual position of sprinkler system, smoke & heat detectors, MCP (manual call points) Hooter, Addressable Automatic control Panel & zonal controlling panels, Fire extinguishers, Valve, hose pipe etc etc should be shown in the SLD.

b. The drawing for accommodation of Electrical Control and Mechanical equipment rooms in all the floors, EPABX, elevator machine rooms, elevator pits, and linen chutes etc. Addressable Automatic control Panel room, must be indicated on the drawings.

6. Vertical Transportation system.

a. Identifying elevator system options for Developers in order to create the most efficient transportation solution for a specific building.

b. Designing elevator systems traffic studies, component specifications, and providing blueprint drawings.

c. Submit detailed design and drawings of elevator system showing actual position of machine room, elevator pits & its wiring, cage size suitable for use of patients, Doctors and Nurses and for fire lift.

7. HVAC System

a. Design drawing of energy efficient HVAC system showing actual position of each component in the blue print like Air handling unit, location of Outdoor Air Intakes and Exhaust, Ducting, Air flow control damper, fire damper and machine room if required etc

8. Video Conferencing

a. Design a HD video conferencing system suitable for real-time interactive communication. Actual position each component like Definition Video Conferencing Codec, Eagle Eye 1080 Camera and license, Microphone array, presentation sharing to remote sites, Infrared Remote control & standard cables should be shown in the drawings.

9. Public Address system.

The bidder should design a efficient **public address system** (**PA system**) showing exact position of each component like microphone, amplifier and loudspeakers in the blue print.

10. Water Supply System

The bidder should design a efficient water supply system showing exact position of each component like type & size of pump, pump room, pump motor, electrical panel, service line etc. in the blue print.

11. Computer Network, Data Centre including high speed internet service.

The bidder should design a efficient computer network including a Data Centre with networking for storage of electronic copies of all documents created from admission to discharge of a patient with electronic reports, usually clinical testing or billing information, into a single electronic folder to reduce labour, eliminate lost files and 'loose sheets,' improve access to authorized users, increase security and provide documentation for claims more quickly showing exact position of each component in the blue print.

12. Mortuary Cooler

a. The bidder should design a suitable, energy efficient mortuary cooler.as per MCI Norms.

13. Lightning Conductor installation.

The bidder should design a suitable lightning conductor to save the installation from lightning. Drawing should show the actual location of air terminal, earth pits etc.

14. Solar Water heating system

The bidder should design a suitable capacity solar water heating system showing actual position of different component like collector, cold water tank, hot water distribution etc. in the blue print.

15. Telecommunications service

The bidder should design a suitable capacity telecommunication / EPABX system showing actual position of all equipment such as telephone with intercom for the use of Drs, nurses on duties floor wise in the blue print.

16. IBMS & IT:

The objective of this report is to give an overview of services designed for the proposed Hospitals. The scope of our design is in the areas of:

Local Area Network (LAN)
Wireless Network Access
Telephone
Closed Circuit Television (CCTV)
Access Control
Servers & Data Storage
Data Security

Broad concept of services:

The services systems for the project have to be conceptualized based on existing experience and acceptable international design standards. Effort shall be made to conceal all services and still provide access to these for accommodating changes in the future. Conservation of energy, optimization of resources, eco-friendliness and state of the art technology shall be the key factors in the design concept to ensure least downtime and reduce maintenance problems. Every effort shall be made to design, layout and install equipment in locations that will tend to encourage routine preventive maintenance by providing easy access for operation personnel. Manual isolation will be provided to enable servicing, expansion or renovation of any part of the system without interrupting the services in adjacent areas.

17. Electrical land scaping both internal and external illumination.

Special lighting fixture with color LED lighting may be used in the portico, waiting areas etc for beautification.
Special light fixtures such as bollard, post top lanterns, path/road lights with octagonal steel pole etc. shall be used to illuminate landscaping areas & internal roads.

1.0 Short Specification to all Services.

The electrical system of this super specialty hospital building and other service areas is proposed to be designed on the basis of National Building Code for such a project giving due consideration to aspects of safety, liability and no interruption in the functions of essential services in the hospital.
Following are the major guidelines followed while designing the electrification and other facility works:

S.L.No.	STANDARDS (Codes of Practice / Guide)	TITLES
1	IS : 732 – 1989 Revision - 3	Code of practice for Electrical Wiring Installation
2	IS : 8061 – 1976	Code of practice for design, installation and maintenance of service lines up to and including 650 Volts.

3	IS : 4347 – 1967	Code of practice for hospital lighting.
4	IS : 10118 (Part – 2) – 1982	Code of practice for selection, installation and maintenance of switchgear and control gear.
5	IS : 10118 (Part 1,2 & 3) – 1985	Code of practice for selection, installation and maintenance of Transformers.
6	IS : 3043 – 1987	Code of practice for Earthing.
7	IS : 694 -1990 (Third Revision)	PVC insulated wires for working voltages up to and including 1100 V.
8	IS : 9537(Part – 2) - 1981 (Amendment - 2)	Conduits for Electrical installations: Rigid steel conduit.
9	IS : 1554 - 1988	PVC insulated heavy-duty cables.
10	IS : 7098 - 1985	High voltage XLPE cable
11	Indian Electricity Rules	

2.0 ELECTRICAL SYSTEM

Entire system is conceived as per the latest standards, guidelines of local Electrical Authority i.e. West Bengal State Electricity Distribution company Limited (WBSEDCL)/CESC Ltd and relevant Indian Electricity rules.

2.1 The normal power supply to the hospital premises shall be available from WBSEDCL at 11 KV and fault level is 350 MVA.
Suitable capacity of HT cable shall be used to connect to. Transformers as per established loads to step down the voltage level at 433 V. Transformers shall be indoor, DRY type and with 'OFF' circuit Tap changers. The transformers shall share the total electrical load of the hospital complex. T he Supply Authority's power supply cable shall enter to the substation building through adequate size of G.I./ RCC heavy duty pipe or PCC ducting where necessary with long radius bend and inspection chambers of suitable size at regular interval as per requirement.

The following equipments shall be accommodated in the substation building:

1) Supplier's Metering Panel
2) 11 KV Distribution board
3) 11/0.433 KV Dry type Transformer of required capacity
4) One or two nos. as required capacity in KVA DG set with auxiliaries for supply of emergent power in case of main power failure.
5) Battery and charger.
6) APFC Panel
7) Main L.T. Panel (Normal and Emergency)

The Transformers shall be protected on the HT side of the consumer, by 11 KV Circuit Breakers i.e. VCB (Vacuum Circuit Breaker) with necessary metering and protection.

2.2 Low Voltage Distribution System

LT power from the secondary sides of the transformers shall be brought through suitable size of LT cables to the Main panel in L.T. Room and from this room to the electrical room at the ground floor of main hospital building. The power supply cable shall enter to the building through RCC/GI heavy duty pipe with long radius bend and inspection chamber of suitable size at regular interval, as per requirements in the electrical room to accommodate Sub LT panel & distribution boards.
The Main L.T. panel shall have Air Circuit Breaker (ACB) as Incomers and bus couplers with 50KA short circuit rating and adequately rated Aluminum bus bars of 50 KA short circuit withstand capacity. All outgoings shall be protected with MCCBs of 25 KA to 35 KA short circuit rating as per requirement instead of conventional switch fuse unit for better operation and maintenance.

2.3 Power Distribution Scheme

Entire system is conceived as per the latest standards, guidelines of local Electrical Authority and relevant Electricity rules.

The Circuit Breakers in Main LT Panel shall be electromechanically interlocked to achieve the conditions mentioned above.

From Main LT panel outgoing feeders, suitable size XLPE cables shall be used to feed power to different distribution boards to cater the various type of electrical loads ie. Bio-medical equipment's, indoor lighting & power points, Lifts, A.C, fire fighting pumps, external lighting etc.

2.4 ELECTRICAL LOAD

(a) Probable Electrical load is estimated for proposed 5 storeyed super specialty hospital building, Service buildings are as under:

Sl. Nos.	Location	AREA (m²) / Nos. UNITS	LOAD IN for light ,fan, 6 amps plug & power plug etc KW/Sqm.	CONNECTED LOAD IN KW	MD IN KW	Maximum demand factor
1)	HOSPITAL Load for light, fan, normal power plug and power plug	7499.8	0.06 KW	449.98 KW	314.98 KW	0.7
2)	MEDICAL EQUIPMENTS LOAD					
i	X-RAY			80.00 KW	80.00 KW	1
ii	RADIO GRAPHY & FLUOROSCOPY (300ma)			21.00 KW	21.00 KW	1
iii	RADIO GRAPHY & FLUOROSCOPY (500ma)			21.00 KW	21.00 KW	1
iv	ENDOSCOPY			5.00 KW	5.00 KW	1
v	AUDEOMETERY			4.00 KW	4.00 KW	1
vi	LAUNDARY EQUIPMENTS			50.00 KW	50.00 KW	1
vii	ANALYSER EQUIPMENTS			15 KW	15 KW	1

viii	DIALYSIS EQUIPMENTS (5 Bedded)			25 KW	25 KW	1
ix	KITCHEN EQUIPMENTS			20.00 KW	20.00 KW	1
x	CSSD			30.00 KW	30.00 KW	1
3)	LIFTS	4	10.00 KW	40.00 KW	40.00 KW	1
4)	W/S PUMPS			15.00 KW	15.00 KW	1
5)	STP			20.00 KW	20.00 KW	1
6)	EXTERNAL LIGHTING			25.00 KW	25.00 KW	1
7)	FIRE JOCKY PUMP			10.00 KW	10.00 KW	1
8)	A/C LOAD			180.16 KW	108.09 KW	0.6
9)	WATER TREATMENT PUMP			7.5 KW	7.5 KW	1
10)	FIRE PUMP			50 KW	50 KW	1
11)	AUTOCLAVE			50 KW	50 KW	1
	TOTAL			**1118.64**	**911.57**	
Considering Diversity Factor at 80%					**729.25**	
TOTAL				say	**729**	
Maximum Load Demand in KVA (0.80 Power Factor)					**911.25 KVA**	
Add. 20% Future Load					**182.25 KVA**	
TOTAL					**1093.50 KVA**	
Transformer loading 85%					**1286.47 KVA**	

Two nos. 750 KVA Dry type transformers are required.

Calculation of DG set capacity for 5 storeyed building

Sr. No.	**Load description**	**Emergency load (KW)**
1	Lights , fans, light & power plug(50%)	225
2	Medical equipment	250
3	Lift 4 Nos. @ 10 KW 50 % of the total load	20
4	Domestic water pump	15
5	Fire Pump	50
6	HVAC (Plant Room) 50 % of the load	90.08
7	STP Pump	20

8	Jockey pump	10	**May be recommended One 1000 KVA Generating set.**
	Total	**680.08 KW**	
	Applying 0.8 power factor of load	850.10 KVA	
	Loading the DG set at 90 % or keeping 10 % as spare capacity.	944.55 KVA	
	TOTAL Say	**950 KVA**	

(b) Probable Electrical load is estimated for proposed 10 storeyed super specialty hospital building, Service buildings are as under:

Sl. Nos.	**Location**	**AREA (m²) / Nos. UNITS**	**LOAD IN for light ,fan, 6 amps plug & power plug etc KW/Sqm.**	**CONNECTED LOAD IN KW**	**MD IN KW**	**Maximum demand factor**
1)	HOSPITAL Load for light, fan, normal power plug and power plug	14838.6	0.06 KW	890.31 KW	623.22 KW	0.7
2)	**MEDICAL EQUIPMENTS LOAD**					
i	X-RAY			80.00 KW	80.00 KW	1
ii	RADIO GRAPHY & FLUOROSCOPY (300ma)			21.00 KW	21.00 KW	1
iii	RADIO GRAPHY & FLUOROSCOPY (500ma)			21.00 KW	21.00 KW	1
iv	ENDOSCOPY			5.00 KW	5.00 KW	1
v	AUDEOMETERY			4.00 KW	4.00 KW	1
vi	LAUNDARY EQUIPMENTS			50.00 KW	50.00 KW	1
vii	KITCHEN EQUIPMENTS			20.00 KW	20.00 KW	1
viii	CSSD			30.00 KW	30.00 KW	1
ix	ANALYSER EQUIPMENTS			15 KW	15 KW	1
x	DIALYSIS EQUIPMENTS (6 Bedded)			30 KW	30 KW	1
3)	LIFTS	4	10.00 KW	40.00 KW	40.00 KW	1
4)	W/S PUMPS			15.00 KW	15.00 KW	1
5)	STP			20.00 KW	20.00 KW	1
6)	EXTERNAL LIGHTING			25.00 KW	25.00 KW	1
7)	FIRE JOCKY PUMP			10.00 KW	10.00 KW	1
8)	A/C LOAD			344.64 KW	206.78 KW	0.6
9)	WATER TREATMENT PUMP			7.5 KW	7.5 KW	1
10)	FIRE PUMP			50 KW	50 KW	1
11)	AUTOCLAVE			50 KW	50 KW	1

	TOTAL			**1728.45 KW**	**1323.50 KW**	
Considering Diversity Factor at 80%					**1058.80 KW**	
TOTAL				say	**1059 KW**	
Maximum Load Demand in KVA (0.80 Power Factor)					**1323.75 KVA**	
Add. 20% Future Load					**264.75 KVA**	
TOTAL					**1588.50 KVA**	
Transformer Capacity at 85% Loading					**1868.82 KVA**	
				Say	**1900 KVA**	

Proposed Two nos 1000KVA Transformers are required.

Calculation of DG set capacity for 10 storeyed building:

Sr. No.	**Load description**	**Emergency load (KW)**
1	Lights, fans, light & power plug (50%)	445.15
2	Medical equipment	250
3	Lift 4 Nos. @ 10 KW 50 % of the total load	20
4	Domestic water pump	15
5	Fire Pump	50
6	HVAC (Plant Room) 50 % of the load	172.32
7	STP Pump	20
8	Jockey pump	10
	Total	**982.47 KW**
	Applying 0.8 power factor of load	1228.08 KVA
	Loading the DG set at 90 % or keeping 10 % as spare capacity.	1364.53KVA
	TOTAL Say	**1400 KVA**

May be recommended two nos. 750 KVA Generating set.

2.5 DISTRIBUTION BOARDS

All lighting and power distribution boards shall be phase segregated double door type, consisting Miniature circuit breakers (MCBs) of 10 KA rating and Earth leakage Circuit breakers (ELCBs) of 30 mA sensitivity and SPD for medical equipment.

All Distribution Boards shall be three phase incoming and single-phase outgoing type. Main incomer shall have a TPN MCB and one double pole ELCB to each of the three outgoing phase bus bars. This prevents the other two phases get tripped OFF in case one phase has the earth fault.

2.5.1 Lighting and small power installation

The lighting and small power installation shall be done with multi strand FRLS, PVC insulated copper conductor wires laid in concealed in slab/wall with M.S. ERW (Medium Protection and Heavy mechanical stress) black conduits of 20 mm. to 40 mm. dia. as per requirement.

Wiring shall be done with following size of flexible multi - strand Copper conductors.

1) Main Lighting Circuit between DB & Switch board. - 2 x 2.5 sq.mm. + 1 x1.5 sq.mm.(E)
2) 6 Amp. Independent point - 2 x 2.5 sq.mm. + 1 x1.5 sq.mm.(E)
3) 6 Amp. Socket on Sw./ board - 2 x 2.5 sq.mm. + 1 x1.5 sq.mm.(E)
4) 6/16 Amp. Power socket (1st point) - 2 x 4 sq.mm. + 1 x 4sq.mm.(E)
5) 6/16 Amp. Power socket (2nd point) - 2 x 2.5 sq.mm. + 1 x 2.5 sq.mm.(E)
6) 32 A. TPN outlet - 4 x 6 sq.mm. + 1 x 6 sq.mm. (E)
7) 40 A.TPN outlet - 4 x 10 sq.mm. + 1 x 10 sq.mm. (E)
8) 63 A.TPN outlet - 4 x 16 sq.mm. + 1 x 16 sq.mm. (E)

The light sub-circuits shall be designed within the permissible limit of 800 watts or 10 points per circuit. The design basis of circuits shall be limited to a voltage drop of 2.5% max.

Load balancing shall be carried out in three-phase circuit only. The overall load balancing including single phase & three phase circuits in main panel shall be considered as per the connected load. The colour band of PVC copper wire both in single phase and three phase distribution should be maintained in all the installation for phase balancing.

3.0 POWER FACTOR IMPROVEMENT USING CAPACITORS

Generally the Supply Authority supplies power at a power factor of 0.8 and the p.f. drops even more at the consumer end depending upon the nature of the load. Therefore the Supply Authority insists that the load power factor do not fall below a level of 0.95 at the consumer end. To keep the Power Factor constant at and above the permitted level, suitable number of capacitor banks of different KVAR rating has to be connected to the load side of the main LT panel. Suitable capacity of (APFCR) automatic Power Factor correction Relay and other auxiliaries will be built in to achieve the automation in this respect.

4.0 ILLUMINATION

Illumination design shall be done with relevant guidelines laid down in National Building Code & IS: 4347 - 1967.

Generally the light fixtures shall be with high frequency electronic ballast and energy efficient

fluorescent (T5) / compact fluorescent lamps with daylight or warm daylight ambience and decorative GLS / CFL / MH / LED fittings in the special areas taking into account the aesthetic part as well.

a) Offices, doctor's room, small halls, dispensaries, laboratories etc. shall be provided with surface/ recess mounted mirror optics / box type general purpose fluorescent fittings.

b) All washbasins shall be provided with fluorescent/ CFL mirror lights.

c) Staircases, storerooms etc shall be provided with general box type fluorescent/CFL fittings.

d) General lighting in Operation Theatre shall be provided with S urface / Recess mounted mirror optics light fixtures having low glare index.

e) All wards shall be provided with surface / recess mounted fluorescent (T5) fittings.

f) Internal road areas shall be provided with post top lantern / street light poles with metal halide / sodium vapour/LED fittings.

g) Entrance / corridor / lobby etc. shall be provided with circular / square type CFL / fluorescent fittings.

4.1 ILLUMINATION LEVEL

LOCATION	Illumination Level (LUX)
Reception & waiting rooms	200
General wards & beds	100 – 150
Operation Theatre – General- Operation Table	300 +Special Lighting
Consulting Rooms	200
Radiology Department	150
Casualty and OPD	150
Dispensaries	300
ICCU / ICU	300
Dining Rooms	150
Laundries (washing, drying, sorting, ironing etc.)	200
Kitchen	200
Cash Counters	200
Surgeries – General- Chairs	300 +Special Lighting
Stairs & corridors	100
Substation & Electrical Rooms	200
Toilets	100
X- Ray room	200
ECG room	300
Pharmacy	300

Clinics	200
Doctors / Nurse room	200
Gymnasium	200
Entrance	150
Area / Street Lighting	30 - 40

4.2 EXTERNAL LIGHTING

The external lighting system consist a main feeder pillar and required numbers of sub feeder pillars in which adequate number of outlets shall be provided for further distribution to street light poles and landscape lighting.

To propose non-conventional energy like Solar Power to be used for area illumination during the non-monsoon season. A required size of active photoelectric cell panel shall be designed for this purpose. During monsoon, due to non-activity of solar panel, alternative power shall be fed to the main external feeder pillar from LT panel.

At road crossings, underground XLPE / PVC armoured cable shall run in RCC Pipe/PCC Trench of suitable sizes, to feed power to various poles..

Special light fixtures such as bollard, post top lanterns, path lights etc. shall be used to illuminate landscaping areas & internal roads.

5.0 SWITCHES AND SOCKETS

All switches and sockets shall be Modular plate type to facilitate compatibility of the modern trends. Industrial socket will also be provided where required.

6.0 EMERGENCY POWER SUPPLY

Apart from the normal power supply alternative source of power supply is required as emergency supply for the following electrical loads, which are to be marked as emergency/ critical loads.

1. Lighting & power in OTs, SCBUs, ICUs, Pre & Post operation, delivery, nursery, emergency blood banks, laboratories, wards etc.- 100%

2. Light in service area like LT panel room, AHU room, A.C. Plant Room, substation, lift M/C room, staircase etc.- 100%
3. General wards, corridors, toilets, offices and other areas- 20 to 50%
4. EPABX/Fire panel
5. Sump pumps
6. Water pump
7. Jockey pump and Booster pump
8. Fire hydrant pump
9. Elevator
10. UPS

7.0 UNINTURREPTED POWER SUPPLY (UPS)

UPS of required KVA capacity is to be installed in the UPS room/electrical room. Supply shall be given from UPS panels at ground floor to various floor DBs connected to medical equipment in OT, ICU, SCBU, Laboratory, Delivery Room, Exit Route, one point in each ward and telephone exchange etc. UPS panel shall be connected to LT panel through PVC armoured flexible cables and the UPS DBs shall be connected to UPS panel through PVC insulated FRLS copper wire.

8.0 VISUAL DISPLAY SYSTEM

Visual display units shall be installed at strategic locations especially in entry area, reception, OPD, emergency, impatient waiting halls to display health education programmes and general health awareness.

9.0 EARTHING

The entire earthing system shall be provided as per IS: 3043. The earthing system will be made extensively available throughout the building with each electrical panel and equipment earthed securely. Copper earthing ie. Copper plate earth electrodes and copper conductors shall be used for Medical equipment , O.T grid and neutral earthing of Transformers and DG sets. Each neutral will be connected to 2 different copper plate earthing stations.

GI plate Electrodes will be used for body earthing of transformers/ D.G.Sets / electrical panels and general earthing.

Pipe earthing shall be provided for street light poles/Feeder Pillar.

10.0 LIGHTNING PROTECTION

Due to hospital building, the lightning protection system should be ion emission type ie. Early Steamer. The device shall be installed at the topmost position of the building. G.I. strip shall be used as earth conductor and (as per relevant IS code-2309) will be laid from the terminal of the Prevention through the outer surface of the building and duly terminated into earthing station.

11.0 FIRE DETECTION AND ALARM

The Addressable Fire Detection and Alarm System shall cover various rooms of Hospital. The intelligent addressable microprocessor based shall be a software controlled automatic system and shall provide necessary programmed activities and various controls. The system shall consist of central processing units, various man machine interface module transmission system, microprocessor based fire alarm control panels, PC, Printer, Intelligent Addressable Automatic Sensors and interface unit, as applicable.

- Intelligent addressable type system only shall be offered.
- Intelligent addressable type detectors and bases for Standard Application shall be included.
- The Intelligent addressable type detectors shall be designed to detect one or more characteristics of smoke and heat during fire.
- All equipment and accessories shall be designed to operate successfully in Hospital atmosphere.
- The detector shall be suitable for Class – A wiring with return loop
- The detectors shall be plug-in type and shall have common Base
- The visual alarm LEDs in the detector shall be clearly visible from outside by a flashing light of sufficient brightness for healthiness condition.
- The detectors shall have provision for connecting repeat response indicator.
- Cross-zoning of detectors shall be done on software mode.
- All detectors shall have suitable degree of protection to ensure that they do not generate false alarms due to moisture, particularly in non-air conditioned spaces where high humid conditions may prevail.

Fire Alarm System (FAS) shall be provided to establish total control over the life safety services required in the Hospital Building.

The FAS provided shall be able to tie-up the following Mechanical, Electrical & Low Voltage Services into integrated system.

a . Air Handling Units
b. Staircase pressurization fans, Lift shafts and lobbies pressurization fans c . Public Address System
d. Lifts & Escalator

e. Toilet Exhaust System

f. Smoke Evacuation System

The FAS system shall be capable of:

a. Setting smoke sensor sensitivity remotely to either high sensitivity manually or on a pre-programmed sequence i.e, occupied/unoccupied period. The FAS shall be able to recognize normal and alarm normal values that reveal trouble condition, and above normal values that indicate either a Fire alarm condition or the need of maintenance.

b. Read-out or address an actual space temperature at thermal detector points.
The operator shall also be able to adjust alarm and pre-alarm thresholds and other parameters for the smoke sensors.

c. Provide a maintenance / pre-alert alarm capability at smoke sensors to prevent the detectors from indicating a false alarm due to dust, dirt etc.

d. Provide alarm verification of individual smoke sensors. Systems that perform alarm verification a zone basis shall not be acceptable. Alarm verification shall be printed on the printer at the control station's printer to enhance system maintenance and identify possible problem areas.

e. Provide local numeric point address and LED display of the device and current condition of the point. Local annunciation shall not interfere with annunciation from the Fire Control System.

f. Provide outputs that are addressable, i.e., outputs shall have point address.
The operator shall be able to command such points manually or assign the points to logical point groups (Software Zones) for pre-programmed operation.

In the event of fire alarm, but not in a fault condition, the following action shall be performed automatically.

a. The System Alarm LED on the fire alarm control panel (FACP) shall flash. b. A local piezo-electric sounder shall be sounded.
c. The LCD display on the main fire alarm control panel shall indicate all information associated with Fire Alarm condition including the type of alarm point and its location within the premises.

12.1 SCOPE

The basic system requirement is as per National Building Code of India 2005 (Part 4 Fire and Life Safety).

12.2 CODES AND STANDARDS

NBC: National Building Code 2005, Part 4, Fire and Life Safety
TAC: TAC Protection Manual / 1998 (Guidance only)

Good Engineering Practices

IS-1239 / IS-3589 : Specification for GI Pipes
IS-778/14846 : Specifications for Gun Metal gate, globe, and check Values for water supply. IS-814 : Specifications for covered electrodes for metal arc welding of structural steel. BS-5155 : Specifications for C.I. butterfly valve.
IS-1641 : Specifications for C.I. screwed fittings.
IS-903 : Specifications for Branch pipes (long Pattern)

IS-3844	:	Code of practice for installation of internal Fire Hydrant in Multi storeyed building
IS-5290	:	Specifications for hydrant.
IS-903	:	Specifications for coupling double male double female instantaneous pattern for fire fighting.
IS-1879	:	Malleable iron fittings (Parts I to X)
IS-4853	:	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes.
IS-636	:	Synthetic, jacketed hose pipes.
IS-1520	:	Electrically operated multistage / multi outlet pump. IS-5
	:	Specification for painting

12.3 TYPE OF FIRE PROTECTION SYSTEMS RECOMMENDED:

The types of fire protection systems for the buildings and premises shall be as per National Building Code considering the height of the proposed buildings.

a. DESIGN CRITERIA

Fire protection system has been designed to meet the requirement / norms as laid down in provisional NOC from West Bengal Fire Service Department. Apart from the above, guidelines of Indian Standards rules have to be considered in design from the point of good engineering.

For Sprinkler System to be provided, the design basis has been adopted as per the recommendation of applicable of TAC rule.

Portable fire Extinguishers have been envisaged for the overall complex for manual fighting against any outbreak of fire during the incipient stage.

b. DESIGN BASIS

The system has been envisaged with pumps and pipeline for yard hydrant, wet riser & Sprinkler System.

Two numbers horizontal centrifugal main fire pump driven by electric motor, one number Jockey Pump shall be provided for the hydrant / wet riser / sprinkler system. One number Electric Motor driven pump of same capacity shall also be provided as common standby. Piping arrangement for the yard hydrant shall be laid in ring mains to facilitate the availability of adequate water at required pressure at all yard hydrant point and at all landing valves of wet riser system. Isolation is to be provided to ensure availability of the water supply as required near location of fire.

c. STANDARD / CODES

IS : 3844 1989	:	Code of practice for installation of Internal fire Hydrants in multistoried building
National Building Code	:	NBC Part - IV Rules for Automatic
Sprinkler Installation	:	Issued by Tariff Advisory Committee.

d. SYSTEN DESCRIPTION / WRITE UP

The proposed systems comprise of the following:

i) Hydrant / Wet Riser System
ii) Sprinkler System
iii) Portable Fire Extinguisher

13. Design of ELEVATOR components, their installation and operation shall meet with :

IS Codes to be followed are:

IS: 14665-2000	Electric traction lifts.
Part-I	Guidelines for outline dimensions of passenger, goods, service and hospital lifts.
Part-II	Code of practice for installation, operation and maintenance.
	Section 1 - Passenger and goods lifts. Section 2 - Service lifts.
Part-III	Safety rules.
	Section 1 Passenger and goods lifts. Section 2 Service lifts.
Part-IV	Components.
	Section 1 Lift buffers.
IS: 15785-2007	Code of practice for Installation and maintenance of lift without conventional machine rooms.

Short specification:

Supply, erection, testing and commissioning of Bed cum passenger lift travelling from ground floor to top floors, stopping at all floors and all openings are on the same side only with AC variable voltage variable frequency micro-processor control, gear less and equipped with Simplex full collective with/without attendant and ARD complete The scope includes liaison with lift inspector for submission of necessary Form and obtaining license to erect & operate the lift from the Lift Inspectorate & all cost to be included in quoted rate.

The lift car will be stainless steel with vision panel at landing, centre opening stainless steel sliding doors of 1000 mm (min) wide & 2100 mm high. Digital floor position and car position indicator in car and landings with intercom facilities, battery operated alarm bell, Automatic door operation with infra-red door detector and luminous feather tough/hall button, Fireman control switch and emergency light with charger, etc as described in the details specification

The lift car will be stainless steel with vision panel at landing, centre opening stainless steel sliding doors of 1000 mm (min) wide & 2100 mm high. Digital floor position and car position indicator in car and landings with intercom facilities, battery

14. <u>HVAC SYSTEM</u>

Reference Standards:

Following standard & guidelines shall be adopted while designing the HVAC System.

1. National Building Code of India (NBC 2005)
2. Energy Conservation Building Code (ECBC 2007)
3. ASHRAE Hand Books.
   - Fundamentals 2009
   - HVAC Systems and Equipment 2008
   - HVAC Applications 2007
   - Refrigeration 2006
   - HVAC Design Guidelines for Hospital & Clinics - ASHRAE
4. Duct construction standards as per relevant BIS codes & SMACNA standards.
5. Air filters as per ASHRAE 52.1-1992 and 52.2-2007
6. Indoor Air quality as per ASHRAE 62.1-2007
7. Motors, Cabling, Wiring and accessories as per BIS codes.
8. National Electric Codes (NEC)
9. ANSI/ASHRAE/IESNA standard 90.1-2009: Energy standard for building except low rise residential buildings.
10. ASHRAE standard 55: Thermal Comfort.

The specification is required to cover the design, manufacture, testing and delivery, duly for site, for complete Air- conditioning Work.

Critical areas like O.T, ITU, ICCU, PICU, NICU, SNCU rooms are considered to be sensitive areas needing careful control of temperature, humidity, and fresh air quantity, filtration of air and control of pressure so as to avoid contamination from other sources. Critical areas should be kept available for use any time. The units may be running intermittently. OT ITU, ICCU, PICU, NICU, SNCU shall be air conditioning with 3-stage filtration with terminal HEPA filter through laminar flow. Inline booster fans are to be used

15 IBMS & I.T

15.1 SCOPE OF WORK

The objective of this report is to give an overview of services designed for the proposed Hospitals. The scope of design is in the areas of:

Local Area Network (LAN)
Wireless Network Access
Telephone &
Closed Circuit Television (CCTV) and
Access Control
Servers & Data Storage
Conservation of Energy

15.2 BROAD CONCEPT OF SERVICES:

The services systems for the project have been conceptualised based on past experience and acceptable international design standards. Effort shall be made to conceal all services and still provide access to these for accommodating changes in the future. Conservation of energy, optimization of resources, eco-friendliness and state of the art technology shall be the key factors in the design concept to ensure least downtime and reduce maintenance problems.

Every effort shall be made to design, layout and install equipment in locations that will tend to encourage routine preventive maintenance by providing easy access for operation personnel. Manual isolation will be provided to enable servicing, expansion or renovation of any part of the system without interrupting the services in adjacent areas.

15.3 METHODOLOGY OF LAN / TEL DESIGN FOR WB TERTIARY HOSPITALS

Primarily, it would be considered all the hospitals as one unit. Then the connectivity solution becomes easier to understand. An important factor in the connectivity is linking of each hospital to the **S**tate **W**ide **A**rea **N**etwork (SWAN). This makes it imperative that the data and voice (computer and phone) connections are IP based.

Therefore, each hospital will have an IP Exchange. This does not mean that normal phone calls are not possible. With the SWAN infrastructure in place, it means that the hospitals can call each other without incurring any recurring expenses. In fact the hospitals may call any office or administration connected to the SWAN without incurring subscriber charges.

Another advantage of an IP network is the great decrease in the local infrastructure costs. Since there will be only one IP network; a separate phone line infrastructure will not be necessary.

15.4 THE IP INFRASTRUCTURE

⇒ Each hospital will have a Fiber Optic Backbone

⇒ Each floor will have the termination / computer points connected to switches placed

in Network Enclosures on each floor

⇒ These Enclosures will be in turn connected to the Fiber Optic Backbone

⇒ The Backbone will be terminated / originated from the Server Room / Data Centre of each hospital

⇒ The Server Room / Data Centre will have the provision for locating the following equipment in individual Network Enclosures Servers Switches Passive Components

⇒ E P A B X : Adequate Backup for Points and Power need to be provided

15.5 THE END POINT INFRASTRUCTURE

The End Pont Infrastructure begins at the end of the points provided by the IP Infrastructure. These may consist of the following equipments:

⇒ Servers – For HMIS and Email and Internet
⇒ Terminals – For accessing the HMIS
⇒ IP Phones
⇒ Printers and other accessories may also be part of this as well

These are some of the basic points on which the whole IT Infrastructure will grow on.

16. LAN

16.1 OBJECTIVE

The objective shall be to provide infrastructure provisions for LAN and telecommunication backbone within each room or occupied area for data and voice transmission.

Ethernet is standardized as IEEE 802.3. The combination of the twisted pair versions of Ethernet for connecting end systems to the network, along with the fiber optic versions for site backbones, is the most widespread wired LAN technology.

16.2 SYSTEM DESCRIPTION

LAN points will be provided on a need basis. It will be structured with

- Rack Mounted Layer 2 Switches & Core Switches.
- Cat#6e Mounting Chords.
- Cat#6e Patch Panels.
- Cat#6e Horizontal Cables.
- Cat#6e Input / Output Point (Box).
- Cat#6e Patch Chords to the NIC of the PC.

The switches will have uplink ports as and where necessary. The cabling termination will be done by IEEE 568B standards.

All points will be duly marked and numbered especially for future MAC (Moves, Additions & Changes)

No Structured Cables shall be provided for voice transmission. 4 pair telephone wire with a tag block shall be provided.

These cables shall run in dedicated low voltage conduits, away from electrical cables, to avoid any electromagnetic interference.

The following shall be used for carrying wires / cable: -

- UPVC conduits wherever the conduit runs exposed in ceiling or chased in wall.
- HDPE conduits for external, underground laying of OFC
- GI cable trays or cable ladders for carrying multi-conductor cables.

17. CLOSED CIRCUIT TELEVISION SYSTEM (CCTV)

The requirements of security system vary as per client requirement along with its geographical location. Scope of this report highlights security system for Common areas only.

The security system proposed for Common area is very minimum amount in the following form:

Closed Circuit TV System (CCTV)

Following spaces shall be provided with cameras:

- Main entrance
- Reception
- Lift Lobby
- Outside Operation Theatres

The security console shall be located in the centralized security room. This room shall have no windows. Ample space shall be provided to view monitors. Analog DVR based CCTV camera system that shall give monitoring team flexibility in viewing the images from multiple locations.
Care shall be taken to ensure that the number of displays per screen is limited so that "individuals" can be recognized when viewing the display in all areas.

ELECTRICAL SPECIFICATION:
Electrical specification for all facilities for buildings & services shall be as per the details given in Annexure–IV of this document.

SPECIFICATIONS FOR ELECTRICAL WORKS

1.0 GENERAL

To provide a complete electrical system for the distribution of electric power from the point of supply (WBSEDCL), D.G.s to the utilization equipment, and described in these specifications. It will be the bidder's responsibility to work out the exact quantities with drawings as per area program & from work site, which trade provides said equipments, materials, tools and labour.

2.0 SCOPE

The bidder shall supply, install and commission along with requisite spare, maintenance tools and tackles the following equipments and system in the Building. The scope also covers the detailed engineering and calculations of the various equipments/system mentioned hereunder and the same shall be approved by the Owner /Architect prior to execution of the job.

1. 11 KV H.T. Switchboards.
2. Specification of Distribution Transformers
3. Specification of L.T panels and switchgears.
4. Specification for Lighting Protection system.
5. Specification for Capacitor Bank and Capacitor Control Panels.
6. A) Specification of HT cable (XLPE) (11KV)
   B) Specification of LT cables and Wire
7. Specification for Internal Electrical Works.
8. Specification for wiring.
9. Specification for D.G Set.
10. Specification for Intelligent Reporting Fire Detection System
11. Specification for PA System
12. Surveillance Closed Circuit Television (CCTV) System.
13. Specification for Conduiting And Wiring for Telephone System.
14. Specification for Nurse Call System.
15. Specification of Heat Ventilation & Air Conditioning System.
16. Specification of Signage.
17. Specification of Lift.
18. Specification of Pump Motor for Water Supply & Sweage. .
19. Specification of Mortuary Cooler.
20. Solar System
21. U.P.S System
22. Special Condition.
23. List of Approved Make.

This specification defines the basic guidelines to develop a suitable electrical system as necessary for the hospital complex. All data required in this regard shall be taken into consideration to develop a detailed engineering of the system.

Compliance with these specifications and/or approval of any of the Contractor's documents shall in no case relieve the Contractor of his contractual obligations.

All work to be performed and supplies shall be affected as a part of contract requires specific approval/review of Owner or his authorised representative. Major activities requiring approval/review shall include but not be limited to the following:

The engineering activities shall comprise the submission for approval of the following:

- Basic engineering documents e.g. overall single line diagram, area classification drawing, overall cable layout, testing, type test report, guaranteed particulars of all equipments and maintenance manuals.
- Quality assurance procedures.
- Field testing and commissioning procedures.
- Control and protection schemes.
- Load sharing and annunciation scheme,
- Preparation of power supply distribution drawing.

Bidder shall be responsible for:

- Detailed co-ordination with other services, shop drawings for various electrical layouts such as equipment layout, lighting layouts, cabling layouts, earthing and lightning protection layouts, including equipment installation and cable termination details etc. prior to start of work.
- Preparation of bill of materials for cabling, lighting, earthing and miscellaneous items etc.
- Cable schedule.

- Lighting/power panel schedule.
- Interconnection drawing.
- Protection co-ordination drawings/tables for complete power system.
- Shop inspection and testing procedures.
- Field testing and commissioning procedures.
- Preparation of as built drawings for all services.

Bidder shall also be responsible for:

- Any other work/activity which is not listed above however is necessary for completeness of electrical system.

3.0 CODES & STANDARDS

The design engineering manufacturing and the installation shall be in accordance with established codes, sound engineering, practices, and specifications and shall conform to the statutory regulations applicable in the country. Contractor shall obtain all approvals from statutory authorities' e.g. Electrical inspector, pollution control boards, WBSEDCL /CESC as applicable before commissioning of electrical/DGs.

- Indian Electricity Act.
- Indian Electricity Rules.
- Factory Act.
- Pollution Control Act.

IS-732 : Code of practice for electrical wiring installation system voltage not exceeding 650V.
IS-3043 : Earthing.
IS-2309 : Code of practice for the protection of buildings and allied structure against Lightning
IS-7689 : Guide for control of undesirable static electricity.
IS-3716 : Insulation co-ordination application guide.
IS-8130 : Conductors for insulated electrical cables and flexible cords.
IS-5831 : PVC insulation and sheath of electric cables.
IS-3975 : Mild steel wire, strips & tapes for armouring cable.
IS-3961 : Current rating of cables
IS-694 : PVC insulated (heavy duty) electric cables for working. Voltage up to and including 1100 volts.
IS-424- 1475 (F-3) : Power cable flexibility test.
IEC-439/IS-7098 : Specification for cross linked polyethylene insulated PVC sheathed cable for working voltage up to 1.1 KV.
IS-1554 : PVC insulated cables up to 1100 volts.
IS-10810: Test procedures for cables.
IS-6121: Cable glands.
IS-10418: Cable drums.
IEC-754(1) : FRLS PVC insulated cable.
ASTM-D-2863 : Standard method for measuring minimum oxygen concentration to support candle-like combustion of plastic (oxygen index).
ASTM-D-2843 : Standard test method for measuring the density of smoke from burning or decomposition.
ASTM E-662/IEC 754(A)
Standard test method for specific optical density of smoke generated by solid materials.
IEEE-383: Standard for type test class-IE, electric cables, field splicers and connections for power generation station.
IS 13947/IEC 947 : Air circuit breaker/moulded case circuit breaker.
IS-8623: Specification for factory built assemblies of switch gear and control gear for voltage upto and including 1000vac/1200vdc
IS 1018: Switchgear and control gear selection/installation and maintenance
IS-1248 :Direct acting indicating analogue electrical measuring instruments and testing accessories.
IS-13779: Digital measuring instruments and testing accessories.
IS-3156 : Voltage transformer
IS-2705: Current transformer for metering and protection with classification burden and insulation.
-IS -2147 : Degree of protection provided by enclosures for low voltage.
PART 1,11,111 Switchgear and control gear
IS-3427 : Metal enclosed switchgear and controlgear
BS-162 : Safety clearance
IS-3202 : Code of practise for climate proofing of electrical equipment.
IS-375 : Marking and arrangement for switchgear, busbars, main connections and auxiliary wiring.
IS-722 : Ac electric meters
IS-3231 : Electrical relays for power system protection.

IEC-255
IS-5082 : Electrolytic copper/aluminium bus bars
IS-2834 : Capacitors
IS-2713 : Steel tubular pole
IS-335 : Specification for insulating oil
IS-3837 : Specifications for accessories for rigid steel conduit for electrical wiring.
IS-2026&335 : Distribution transformer
(PART I,II,III)GI/STEEL /PVC conduit pipe for electrical wiring.
IS-2274 : Code of practise for electrical wiring installation system voltages exceeding 650 volts.
IS-6665 : Code of practise for industrial lighting
IS-3646 : Interior insulation part 1&2
IS-1944 : Code of practise for lighting of public through fares.
IS-7752 : Guide for improvement of power factor consumers installation.
IS-13346 : General requirement for electrical for explosive gas atmosphere.
IS-13408 : Code of practise for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres
IS-12360 : Voltage and frequency for ac transmission & distribution system.
IS-5572 : Classification of hazardous area for electrical installations.
IS-5571 : Guide for selection of electrical equipment for hazardous area.
IS-4201 : Application guide for Current Transformer
IS-4146 : Application guide for Voltage Transformer
IS-10028: Code of practise for installation and maintenance of transformer
IS-8478 : Application guide for on load tap changer
IS-10561: Application guide for power transformer
IS-1646 : Code of practise for fire safety of buildings electrical installation
IS-3034 : Code of practise for fire safety of industrial building-electrical generating and distribution station
IP-30 : National electrical code (NEC) BIS publication.
IS-4722 : Rotating electrical machines.
IS-4889 : Method of determination of efficiency of rotating electrical machines.
IS-325 : Three phase induction motors.
IS-4729 : Measurement and evaluation of vibration of rotating electrical machines.
IS-900 : Installation and maintenance of induction motors.
IS-4029 : Air break switches.
IS-2208-9224 : HRC cartridge fuses.
IS-2959 : Contactors.
IS-9537 : Rigid steel conduit.
IS-1030-1982 : Specification for carbon steel castings for general engineering purpose.
IS-1601/ BS-649 : Performance& testing of Internal Combustion (IC) engines for general purpose.
AIEE-606(1959) : Recommended specification for speed governing of I.C. engine generator units.
BS-5514/IS-3046 8528(Part-2): Reciprocating IC engine driven A.C. generators.
Any other standard may be followed provided it is equivalent or more stringent than the standards specified above.
In case of any deviation /conflict of this specification with the codes & standards, the following order of precedence shall govern.

a) Specification, particular specification if any, and drawings.
b) Indian regulations/codes and standards.

4.0 SITE CONDITIONS

i) Design ambient 50 Deg.C. maximum
2 Deg. C. minimum
ii) Relative Humidity 85% maximum
iii) Site environment Normal

5.0 DESIGN CRITERIA

a) Electrical Details of Incoming Supply

a)	Supply Voltage	11 KV or 6 KV as applicable
b)	Neutral Earthing	Solid Earthing

c)	Voltage Regulation	± 10%
d)	Frequency Regulations	± 3%
e)	Combined	± 10%

b) L.T. Power Distribution System

a)	Voltage	415 V / 240 V
b)	Frequency	50 Hz
c)	Neutral Earthing	Grounded
d)	Short Circuit Fault withstand Capacity	10 KA - 65 KA (1 Sec.) as per B.O.Q. and specification.

c) Source of Power Supply

a)	Voltage	415 V / 240 V
b)	Source	Mains/D.G. Set

d) Control Supply for Electrical System

The various supply voltage to be used in the control panels for main equipments are:

i)	Spring Charge Motor	230 Volt A/C
ii)	Closing/Trip Coil	24 V DC / 230V AC
iii)	Alarm/Indication/Relay	24 V DC/ 230 V AC
iv)	Heaters	230 V AC

A	POWER SUPPLY LOAD CONTROL/DISTRIBUTION PANEL.	433 V TPN / 240 V 1 phase A.C.
B	PAINTING OF PANEL.	Powder coating of approved shade.
C	PAINTING OF CABLE TRAY AND STRUCTURE STEEL.	Powder coated of approved shade.

6.0 CABLE DETAILS

A	INTERNAL WIRING.	Copper conductor PVC insulated 1.1 KV grade as called for
B	POWER CABLES (L.T.).	XLPE insulated Al. Armoured Cable as called for
C	11 KV	Aluminium conductor XLPE insulated armoured cable.
D	GROUNDING CONDUCTOR.	Copper/G.I. strip as called for
E	LIGHTNING CONDUCTOR.	ESE Type.

7.0 ACCURACY CLASS OF METER

	a) Revenue Meters	Class-0.5 or as per WBSEDCL approved.
	b) Ammeter Voltmeter and Other Instrument.	Class – I Digital Analogue as called for

1. 11 KV H.T. SWITCHBOARD

This specification covers the 'General Requirements' for the design, manufacture, supply performance, inspection, testing and commissioning including supply of indoor type high voltage switch boards upto 11 KV including necessary termination, cabling, bus work required for satisfactory operation .

Specific requirements shall be in accordance with single line diagram/specification/data sheet. In case of conflicting requirement between the Technical Data and General Specification the former shall prevail.

The technical parameters of switchgear equipments, transformers etc. shall be submitted by the Contractor for approval by the employer.

This specification shall cover 11 KV and Single Panel as well as 3 Panel Board.

1.1 STANDARDS

All equipment, material and components shall comply with the requirements of the latest editions of Indian Standards with updated amendments. Standards and Regulations applicable in the area where equipment is to be installed shall also be followed.

The equipment offered complying with other standards, these standards shall be equal to or superior to those specified and full details of the differences shall be furnished along with the tender.

Some of the relevant Indian and British Standards are listed below:

IS 13947 - A.C. Circuit Breakers (Relevant Parts/SCC)
IS 13941 - High voltage Circuit Breaker (Relevant Parts/SCC)
IS13118 - Gas insulated Switchgear
IS 3427 - Metal enclosed Switchgear & Control Gear
BS 162 - Safety Clearances
IS 2705 - Current Transformers (Parts 1 to 4)
IS 3156 - Voltage Transformers (Parts 1 to 4)
IS 3202 - Code of Practice for climate proofing of electrical equipment
IS 375 - Marking & Arrangement for Switchgear Bus Bars, main connections and auxiliary wiring.
IS 722 - A.C. Electric Meters
IS 1248 - Direct acting Electrical Indicating Instruments
IS 3231 - Electrical Relays for Power System Protection
IS 2544 - Epoxy Cast Resin Insulators
IS 5082 - Electrolytic Copper and Aluminium
IS 5792 - High Voltage HRC fuses
IEC 60694- High Voltage Switchgear
IEC 60947- High voltage Circuit Breaker
IEC 60056- Gas insulated Switchgear
IEC 60298- Metal Enclosed High Voltage Switchgear

1.2 DETAIL OF DESIGN

a. CONSTRUCTION

The switch boards shall be cubicle type, suitable for indoor/outdoor installation, floor mounting and free standing. The design shall be totally enclosed, dust - tight, dam proof and vermin proof offering degree of protection not less than IP-42 for Indoor Application & IP-54 for Outdoor application.

Separate segregated compartments shall be provided for circuit breakers, bus bars, cable box, voltage transformers, wire ways, relays, and instrument and control devices. Switchgear cubicles/ modules shall be provided with hinged doors in front with facility for padlocking door handles.

Vent openings shall be covered with grills so arranged that hot gases cannot be discharged through them in a manner that can injure the operating personnel. These vent openings shall be vermin proof.

All the High Voltage compartments i.e. Circuit Breaker, Bus Bar, and Cable Compartments shall be separated from each other by metallic partitions in line with IEC-600298. These compartments must have pressure relief flaps for exit of gas due to internal arc to ensure operators safety. All the HV design must ensure conformity to IEC-600298 and must be Type tested for Internal Arc Test. The supplier shall submit Type Test report from CPRI or other independent agency to prove the above.

All panels shall be of same height, width and depth. Panels shall be bolted together to form a continuous flush front switch board, suitable for front of board operation.

The switchgear cubicles shall be rigid and robust in design and construction, fabricated out of CRCA sheet steel. Cubicles shall be made from rigid welded structural frames made of structural steel sections or of pressed/formed

sheet steel of not less than 2mm thickness. The frames shall be enclosed by sheet steel of at least 2mm thickness, smoothly finished, leveled and free from flaws. Stiffeners shall be provided wherever necessary. Height of the operating handle, push button etc. shall be restricted between 300 mm to 2000 mm from the finish floor level. Fixing screws and nuts shall be used. Self-tapping screws shall not be used in the construction.

All doors, panels, removable covers shall be provided with non deteriorating (neoprene) gaskets all around the perimeter.

All doors shall be removable and supported by concealed type hinges. The hinges shall be strong and braced to ensure freedom from sagging, bending and general distortion of panel or hinged part.

Floor mounted cubicles with minimum 75 mm high channel and 5 mm thick channel base frame. Approx 200 mm-blank space between the floor of the switchboard and bottom most units shall be provided. The total height of the cubicle shall not exceed 2400mm.

b. BUSBARS & BUSBAR CHAMBER

Three phase bus bars shall be of high conductivity electrolytic copper as stated in B.O.Q. The bus bars shall be air insulated and housed in a separate compartment, which segregated from all other compartments, in case of Vacuum Circuit Breaker. In case of Gas Insulated Circuit Breaker the Bus Bars shall be housed in separate SF6 gas filled stainless steel tank. Current density of **Cu. Bus-Bar** shall not exceed 1.5 Amps / mm^2

Bus bars & bus bar connections shall be of uniform cross section shall be suitable for carrying rated current continuously and short circuit current for specified duration without overheating. The bus bars connections shall be adequately supported on insulators to withstand dynamic stresses due to short circuit current specified. Normal operating temperature for bus bars shall be 85 Deg. C. Short circuit rating of the bus bars shall be 35 KA for 1 sec.

All bus bar joints and bus tap joints shall be silver or tin plated. Joints shall be bolted type and shall be insulated. Spring/Lock washers shall be provided to ensure good contact the joints.

Direct access to accidental contact with bus bars and primary connections shall be avoided by providing shrouds. All apertures and slots shall be protected by barriers to prevent accidental shorting of bus bars. To provide a tight seal between cubicles, bushings or insulating panels shall be provided for bus bars crossing from one cubicle into another.

All insulating materials used shall be non-hygroscopic and shall be treated for preventing fungus growth. Surface of insulators shall be highly glazed and treated with silicone compounds to minimize accumulation of dust, condensation and tracking.

c. CIRCUIT BREAKERS

The circuit breakers shall be Triple Pole double break type and the Insulation and Arc interruption medium shall be either Vacuum or SF6 gas medium. The Breaker shall be enclosed in a sealed Vacuum Tank or SF6 gas filled Stainless Tank. A pressure relief device along with Manometer shall be provided with the Tank in case of SF6 CB to release and monitor any excessive pressure and for testing purpose.

The circuit breakers shall be of horizontal draw out construction with horizontal/vertical isolation. The circuit breaker including its operating mechanism shall be mounted on a wheeled carriage moving on guides, designed to align correctly and allow easy movement on the circuit breaker. There shall be three discrete positions viz. Service, Test and Isolated. Locking facility in all three positions shall be available. Position indicator shall be provided on the panel to indicate the position of the circuit breaker. Test position shall offer testing of circuit breaker operation/interlocks without energizing the power circuit.

Circuit breakers shall have stored energy spring mechanism charged by manually operated handle as well as electrically operated mechanism. The closing mechanism of the circuit breakers shall be Motor operated, spring charged with a provision for manual charging.

The operating mechanism shall be mechanically and electrically trip free and non-pumping. Anti-pumping feature may be built in or separate anti-pumping relay may be provided. In case spring charged mechanism, spring charged indication shall be provided.

Local manual trip device shall be provided on the operating mechanism. The trip device shall be suitable for front operation and positive mechanical 'ON-OFF' indication shall be provided.

Main contacts of circuit breaker shall have ample area and adequate contact pressure to carry the rated and short time current without excessive temperature rise. The contacts shall be adjustable for wear and easily replaceable. Main contacts shall open before and close after the arcing contacts when these are provided. Arcing contacts shall be easily accessible for inspection and replacement in case of VCB.

Each breaker shall normally be provided with auxiliary contacts of 6 NO+6NC directly operated from breaker operating mechanism. These contacts shall be in addition to these used in circuit breaker internal wiring. These contacts shall be rated for 10 Amps at 240V AC and 20 Amp (inductive breaking) at 220V D.C. If more breaker auxiliary contacts are required latching relay shall be used to multiply the contacts.

Shunt trip coil as called for shall be provided for tripping the circuit breaker. The trip coil/s shall operate satisfactorily between 50% - 110% of rated control voltage. Wattage of trip coils will be sufficiently high to prevent it from picking up or holding on with specified number of trip circuit supervisory indicating lamps wired in series.
It shall be possible to trip the breaker, in case of failure of control supply
Circuit breaker type duty and rating shall be submiteed in Data Sheet by the Contractor.
Circuit breakers of similar rating shall be interchangeable.

d. CURRENT TRANSFORMERS

Current transformers shall be of ratio, burden (shall be worked out by panel supplier), class/accuracy.
Current transformers shall conform to latest edition to relevant standards. Current transformers shall be epoxy resin cast with bar Primary or ring type.
CT core laminations shall be of high grade silicon steel. The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses due to the maximum short circuit current of the circuit.
The current transformer shall preferably be capable of being left open circuited on the secondary side with primary carrying rated full load current, without overheating or damage. Short time current rating and rated withstand time shall be same as corresponding C.B.
Secondary terminals of CT shall be brought out to a terminal block which will be easily accessible for testing and external connections. Facility shall be provided for short circuiting and earthing of CT secondary leads through a removable and accessible link with provision for attaching test link.
Rating plate details and terminal markings shall be according to the latest edition of relevant Indian Standard specification.
Current transformers (core) shall be used for metering and protection. Each CT shall be provided with rating plate indicating: Name and Make, Serial number, Transformer Ratio, Rated burden, Rated voltage and Accuracy class.

e. POTENTIAL TRANSFORMERS

Potential Transformers shall conform to latest edition of "IS-3156 (Part I, II & III) as applicable relevant standards.
Potential transformers shall be dry, cast epoxy resin type. The PTs shall be of single phase construction.
The PT shall be capable of operating continuously at 110% of the rated voltage without any damage. When star - star connection is required in non-effectively or ungrounded system, the PTs shall be suitable for continuous operation with a persistent phase to ground fault.

Maximum temperature rise of the transformer at rated burden and with rated primary voltage and frequency shall not exceed 40 Deg.C above an ambient of 45 Deg.C.
The PT's shall be fixed at rear bottom / top of the panel as called for. An interlock or automatic shutters shall be provided to prevent access to live HV parts when PT is withdrawn.
HRC Fuses shall be provided both primary & secondary side. It shall be possible to replace PT fuses easily without having to de-energize the main bus bars. Prospective interrupting current rating of the fuses shall be same as the system fault level.
Voltage transformer ratio, output and class shall be specified and shall be stated in data sheet by the Vendor/Contractor. Nameplate as per relevant standards shall be provided on the PT.

f. PROTECTIVE RELAYS

Relays type and numbers shall be in accordance with the protective scheme required.
Relays shall be digital microprocessor based or analogue type, as called for in BOQ. It shall be enclosed in rectangular shaped cases, suitable for flush mounting only, dust tight covers projecting from the front cover panel. The case shall be dust tight, damp proof and tropicalised. The relays shall be either self-powered or a 24V DC Power-pack of suitable capacity with charging device shall be provided within the HT panel.
Relays shall be accessible for setting from the front. Access to setting devices shall be possible only after removal of front cover.
Protective relays shall be drawing out type. Where it is not possible to provide protective relays of the draw out pattern, fixed type relays with facilities for plugging in a portable test plug shall be provided. Necessary test plugs shall be furnished along with the relays.
Relays shall be provided with positive action self reset type with indicator. The indicator/s shall be visible from the front.
Relays conform to relevant standards in all respects. Relays shall be provided with minimum two pairs of self or hand reset type contacts as specified. Auxiliary relays shall have the number of NO and NC contacts as required and shall be in data sheet by the Vendor / Contractor.

g. SAFETY/PROTECTION INTERLOCKS/FEATURES

Following interlocks and features shall be incorporated for equipment protection and personnel safety under mal-operation. No deviations on these interlocks and safety features are allowed. These interlocks and safety features shall be fail-safe, positive and fool-proof.

a) It shall not be possible to plug-in or isolate a closed circuit breaker. An attempt to do so shall trip the breaker. (In case of breakers with vertical isolation, this will apply to raising and lowering). There shall be a positive locking facility to prevent closing of circuit unless it is in Service or Test position.

b) Closing and opening operations shall be possible only in discrete, well defined Test and Service positions and not in any position midway. An extension adapter cable with plugs and sockets shall be preferably be provided so that the closing and opening operation of the circuit breaker can be done in fully withdrawn position outside the cable.

c) Slow operation of circuit breakers shall be possible only in the circuit breaker in Test or Isolated position.

d) Isolating switches if provided shall be interlocked with respective circuit breakers to prevent them making or breaking the current.

e) 1 no. bus earthing truck shall be supplied with each panel to earth the outgoing cable of the VCB.

f) Automatic safety shutters for all openings which will lead to access to the live parts of the switchgear upon withdrawal or any operation the switchgear components/parts shall be provided, preferably with a padlocking facility.

g) Spring of motor operated spring charged mechanism shall not discharge until they are fully charged and charging means are fully disconnected.

h) Where key interlocking is employed, tripping of a closed circuit breaker shall not occur if any attempt is made to remove the trapped key from the mechanism.

i) Annunciation window shall be provided for winding temperature trip / alarm as required.

j) Any other interlocks which manufacturer may deem to be required for safety and specifically specified separately required for the system shall be included.

k) All terminals, connections which may be live and exposed for accidental contact shall be adequately shrouded.

l) Components within cubicles shall be properly labelled to facilitate testing.

h. EARTHING

The switch board shall be provided at the bottom throughout its entire length with an earth bus of copper of adequate size to carry the fault current for the duration same as short time rating of the circuit breaker. Earth bus shall have two earthing connection facility at its both ends of earthing conductor.

All non-current carrying metal parts, frames and equipment mounted in the switchboard shall be bonded to earth bus. Earthing of moving carriage of drawout equipment shall be achieved by scraping earthing device. The earthing device shall maintain positive earth continuity in all Service Test and Isolated positions.

It shall be possible to connect each circuit or set of three phase bus bars to earth either through earthing trucks or through the circuit breakers.

One earthing trolley suitable for earthing of cables or bus bars and common for all circuit breakers of the same type/rating shall be provided.

i. INSTRUMENT & METERS

Electrical indicating instruments shall be digital type with zero adjustment, probe from outside the cover.

Multi function meter of CL 1.0 accuracy with RS 485 port shall be provided.

Instruments/meters shall be suitable for flush mounting on the panel with flanges protecting outside the panel.

All meters shall be industrial grade with accuracy of class 1.0 unless specifically indicated.

j. CONTROL WIRING

All wiring for control, protection, alarm, indicating circuits and remote tripping mechanism on all equipment shall be carried out with at least 650V grade, PVC insulated, stranded, copper, 2.5 Sq.mm conductors.

All wiring shall be run on the sides of the panels and shall be neatly bunched and cleated without affecting access to equipment mounted in the panel. Where wiring enters or passes through compartments containing HT apparatus then they shall be in earthed metallic conduits or ducts.

All wiring shall be taken to terminal blocks without joints or tees in their run.

All wiring shall be colour coded as follows:

Instrument Transformer AC circuit	-	Red, Yellow & Blue determined by the Phase with which the wire is associated.
AC Phase Wire	-	White
AC Neutral	-	Black
DC Circuits	-	Grey

Earth connections - Green

Engraved core identification ferrules, marked to correspond with the wiring diagram shall be fitted to each wire. Ferrules shall fit tightly on the wires, without falling off when wire is removed. Ferrules shall be of white colour with black lettering. Each wire shall be identified by letter to denote its function followed by a number to denote its identity at both ends.

All wiring for external connections shall be brought out to individual terminals on a readily accessible terminal block.

All unused auxiliary contacts of the circuit breaker and relays shall be wired upto terminal block.

k. FITTINGS AND ACCESSORIES

Indicating Lamps:

Neon type indicating lamps or LED indicators shall be provided everywhere except where low voltage filament type with series resistor called for.

Lamp covers shall be provided with interchangeable colored lenses of Perspex or equivalent unbreakable material. The lenses shall not discolor in course of time due to heat of the lamp.

Bulbs and lenses shall be interchangeable and replaceable from the front.

Following colors shall be used for the function indicated:

Red - Circuit Breaker 'ON'
Green - Circuit Breaker 'OFF'
White - Continuous trip supply supervision
Amber - Auto trip
Blue - Spring charged
R.Y.B - Potential indication
Green - Earth

Push Buttons:

All push buttons shall be push to actuate the contact type.

Start & Stop push buttons shall be colored green and red respectively. Reset push buttons shall be yellow in color and test push buttons shall be blue in color. All other push buttons shall be black in color.

Emergency stop push buttons shall be lockable in the operated position, i.e. push to operate and key to release type. Push buttons for emergency stop shall be recessed/shrouded type to avoid accidental operation.

Control & Selector Switches:

Control and Selector switches shall be of rotary type, having enclosed contacts accessible only after removal of cover.

All control and selector switches for circuit breakers and instruments shall be mounted on the front of the panel. Control switches for space heater/s and control supplies shall be mounted inside the panel.

Circuit Breaker control switches shall be provided with pistol grip handles. Selector switches shall be provided with round, knurled handles. All handles shall be black in colour. Properly designated escutcheon plates clearly marked to show the operating positions shall be provided on all switches.

All other instruments and selector switches shall have stay put contacts.

Circuit breaker control switches shall normally have three positions close - Normal - Trip with spring return to normal position. Switch operating mechanism shall prevent the switch from being operated twice successively in the same direction. Circuit breaker control switch shall have one NO-NC contact along with other contacts as required.

Contacts of all control and selector switches shall be rated for 10 Amps at 240V AC or 20 Amps at 220V dc (inductive break). Switch for space heater supply and control voltage supply shall normally be two pole rated for 25A A.C.

Control Terminal Blocks:

Box - clamp type, 1100V grade line up terminals of minimum 2.5 Sq.mm size shall be provided. Connection to terminals shall be from front.

Not more than one wire on each side shall be connected on any terminal. Where duplication of terminals block/s is necessary, suitable solid bonding links shall be incorporated. Terminal blocks at different voltage shall be segregated into groups and distinctly labeled. Current transformer secondary leads shall be brought to terminal blocks having facility for short circuiting and grounding the secondary.

Terminals shall be numbered for identification and grouped according to function. Engraved back on white PVC labels shall be provided on the terminal blocks describing the function of the circuit.

Separate terminal stems shall be provided for internal and external wiring.

Control terminal blocks shall be so located that control cables are fully segregated from power cables. Suitable insulated or earthed metal race ways shall be provided for control wiring. Separate undrilled removable gland plate shall be provided for the control cables at the bottom of each panel.

Minimum 10% of total number spare terminals shall be provided for future use.

Name Plates and Labels

One Name plate giving designation of the HV switchboard shall be affixed prominently on top of the switch board. Details of designation will be specified.

Labels giving following details shall be affixed on each feeder panel:

i) Feeder Name.

ii) Equipment reference no. & Description

iii) Rating (KVA/Amp.)

All components whether mounted inside or on the door shall be permanently and clearly labelled with reference number/letter or their function. Rating of fuse shall be part of fuse designation. Paper labels, stickers or labels fixed with adhesives are not acceptable. All labels shall be properly fixed by screws with provision to prevent distortion due to expansion.

All labels shall be non-corroding, preferably laminated plastic or rear engraved perspex with white letters on black background.

Labels for feeder panel designation fixed on front side shall be fitted with chrome paste, self tapping, and counter sunk head screws. These labels shall be of identical size to permit interchange.

Space Heaters:

Adequately rated anti-condensation space heaters shall be provided in each cubicle.

Space heater/s shall be trip type, rated with operation voltage of 240V, 50 Hz. AC supply.

Each space heater shall be complete with a 2P MCB, 10KA and a control thermostat.

The space heater shall be rated for maintaining the panel inside temperature 10 Deg.C above outside ambient temperature.

Cubicle Lighting:

Each cubicle shall be provided with interior lighting by means of CFL light fixture. An ON/OFF switch/door switch shall be provided. The lighting fixture shall be suitable for operation from a 240V single phase, 50 Hz. A.C. supplies.

Auxiliary Supply:

Auxiliary supply for control, indication, space heater etc. shall be made available at one point on the switch board. Vendor shall provide suitable auxiliary supply in the switch board.

Fuses:

All fuses in control, indication and metering circuit shall be HRC link type of approved make. Mounting of fuse fitting shall ensure adequate dissipation of heat generated and shall facilitate inspection and easy replacement of fuse.

Cable Termination:

The switch board panel shall be provided with separate compartment for cable termination complete with suitable cable end termination for XLPE insulated cables suitable for bottom entry. Cable and sealing box shall preferably be mounted inside the panel. Cable compartment doors shall be self–locking type, interlocked and shall have Arc withstand capability due to short circuit. The compartment shall be provided with cable testing facility in case of gas insulated medium. For XLPE cables adequate space and clearances shall be made for heat/cold shrinkable termination e.g. Raychem or cold flowing stress grading joints.

Two earthing terminals shall be provided in each panel in cable box/cabling chamber for earthing armour/screen.

Where more than one core is terminated on each phase, links suitably designed and properly supported shall be provided to avoid unnecessary bending of cable cores without decreasing the length of insulated cable tail. Electrical clearances which would normally be required when using one core per phase shall be maintained.

Where core balance type current transformers are provided on switchgear feeder circuit cable/s for earth fault protection sufficient space, clearance and support, mounting arrangement shall be provided for the CT.

Painting:

All steel work shall be pretreated in tanks and finally powder coated of approved shade of the levels not less than 100 microns.

1.3 TESTING & INSPECTION

Four copies of all test certificates and certificates shall be furnished. After completion of all work at the manufacturers works the switchboards shall be inspected and tested in presence of employer or his authorized representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.

ii) Test for protective relay operation by secondary injection method.

iii) Operation of all meters.

iv) Secondary wiring continuity test

v) Insulation test with 1000 Volts megger, before and after voltage test.

vi) HV test on secondary wiring and components on which such test is permissible (2 KV for one minute)

vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.

viii) Measurement of power required for closing/trip coil of the breaker.

ix) Pick up and drop out voltages for shunt trip and closing coils.

x) CT Polarity test.

xi) Power frequency voltage withstand test.

Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out along with copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before dispatch of switch boards.

1.4 DRAWINGS AND INFORMATION

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cut-outs/trenches for external cables

ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.

iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.

iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.

v) Relay wiring diagrams.

vi) Equipment List.

vii) Bus bar sizing calculations.

Vendor shall furnish required number of copies of above drawings for Purchaser's review, fabrication of switch boards shall start only after Purchaser's clearance for the same. After final review, required number of copies and reproducible shall be furnished as final certified drawings.

The information furnished shall include the following:

i) Technical literature giving complete information of the equipment.

ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.

iii) A comprehensive spare parts catalogue.

1.5 TOOLS

One complete set of all special or non-standard tools required for installation, operation and maintenance of the switchboard shall be provided. The manufacturer shall provide a list of such tools individually priced with his quotation.

1.6 QUALITY ASSURANCE

Quality Assurance shall follow the requirements of employer as applicable.

Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

2. <u>SPECIFICATION OF DISTRIBUTION TRANSFORMER</u>

2.1 DRY TYPE INDOOR DISTRIBUTION TRANSFORMER

a. SCOPE:

The specification covers design manufacture, testing packing and delivery of 3 phase 50 Hz, Dry Type distribution transformer (Outdoor & Indoor) ONAN confirming IS: 2026 1981 Part (I TO IV), IS: 11171 1985 and IEC 76.

The equipment offered shall be complete with all necessary parts for effective and trouble-free operation in the distribution system. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.

b. SYSTEM PARTICULARS:

The transformers shall be suitable for outdoor/indoor installation with following system particulars and should be suitable for service under fluctuations in supply voltage as permissible under Indian Electricity Act & Rules there under.

Nominal System Voltage : 11Kv

Corresponding Highest System Voltage	:	12kV
Neutral earthing	:	Solidly earthed
Frequency	:	50 Hz with ±3 % Tolerance

c. SERVICE CONDITIONS:

Equipment to be supplied against the specification shall be suitably design to work satisfactorily under following tropical conditions:-

Max. Ambient air temperature	:	50 Deg. C
Max. Relative humidity	:	100 %
Max. Wind pressure	:	150 kg/sq.m.
Max. Altitude above mean sea level	:	1000 mtrs.
Seismic level(Horizontal acceleration)	:	0.3 g.

d. DESIGN & CONSTRUCTION:

CORE:

The core shall be of high grade cold rolled grain oriented (C.R.G.O) annealed steel lamination, having low loss and good grain properties, coated with insulation, bolted together to the frames firmly to revent vibration or noise. All core clamping bolts shall be effectively insulated. The complete design of core must ensure permanency of the core losses with continuous working of the transformers.

Core insulation –C-Class grade insulation paper of thickness 20 mils (0.5 mm) shall be used and make should be clearly stated in the offer along with test certificates.

The successful bidder shall be required to submit the manufacturer's test report showing the Watt Loss per kg and the thickness of the core plate, to ascertain the quality of Core materials.

The purchaser reserves the right to get tested at any Government recognized laboratory.

The transformer core shall not be saturated for any value of V/f ratio to the extent of 112.5% of the rated value of V/f ratio (i.e. 11000 / 50) (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and will not get saturated. The bidder shall furnish necessary design data in support of this situation.

HT/LT CABLE BOXES:

Suitable arrangement for HV side box and LV side box shall be provided. The LV cable box shall be suitable for terminating the cables, which will approach the boxes vertically from the bottom. The cable box shall be suitable for being detached from the main body with suitable mounting arrangement.

The H. T. and L. T. cable box shall be fixed on the opposite sides.

TEST AND INSPECTION:

i. Routine Tests:

All transformers shall be subjected to the following routine tests at the manufacturer's works. The tests are to be carried out in accordance with the details specified in IS 2026 or as agreed upon between the purchaser and the manufacturer.

Measurement of winding resistance.
Ratio, polarity and phase relationship.
Impedance voltage.
Load losses.
No-load losses and No-load current.
Insulation resistance.
Induced over voltage withstand.
Separate source voltages withstand.

All the routine tests shall be conducted in the suppliers' laboratory at their cost.

ii. Type Tests:

In addition to routine test as above Impulse voltage Withstand test and Dynamic Short Circuit Test as under shall be successfully carried out at laboratories accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with IS 2026/1977 as amended from time to time and technical specifications, within the last 5 (five) years prior to the date of offer. The bidder shall furnish the following type tests reports (along with General arrangement drawing, Rating and Diagram Plate and Internal Constructional drawing).

Impulse Voltage with stand Test on all three LV & HV phases chopped on tail.

Dynamic Short circuit Test.
The following balance type test should be carried at the manufacturer's works invariably in the presence of representative at the time of inspection from the first lot.
Temperature Rise Test
Unbalanced current test – unbalanced current should not be more than 2% of full load current.

iii. Submission Routine Test Certificate:

The manufacturer shall submit the routine test certificate along with documentary evidence for having paid the Excise Duty for the following raw materials viz. copper for conductors, insulating materials, core materials, bushings at the time of routine testing of the fully assembled transformer.

3.SPECIFICATION FOR L.T. PANELS & SWITCHGEARS

Medium voltage switch boards/distribution boards, the combination of both these and components shall conform to the equipments of the latest revision including amendments of the following codes and standards.

3.1 CODES & STANDARDS

The design, manufacture and performance of equipment shall comply with all the currently applicable statues, safety codes, relevant Bureau of Indian Standards (BIS), British Standards (B.S.), International Dutro Technical Commission (IEC) Publication, NEMA, IDE & DEMA standard as ammended upto date.

a)	IS:13947-1993/IEC 60947-1989	Air circuit breaker/moulded case circuit breaker.
b)	IS:3156	Voltage transformers.
c)	IS:2705 Part-I, II	Current transformers for metering and protection with classification burden and insulation.& III 1964
d)	IS:9224	Low voltage fuse and protection.
e)	IS:3231	Specification for electrical relays for power system protection.
f)	IS:8623	Specification for factory built assemblies of switchgear and control gear for voltage upto and including 1000-V AC/1200 V-DC.
g)	IS:4237	General requirements for switch gear and control gear for voltage not exceeding gear.
h)	IS:2147	Degree of protection provided by enclosures for low voltage switch gear and control gear.
i)	IS:1018	Switchgear and control gear selection/installation and maintenance.
j)	IS:1248	Direct acting electrical indicating instruments.
k)	IS:375	Arrangement for switchgear, bus bars, main connections, auxiliary wiring and marking.
l)	IS:2959	AC contactors for voltage not exceeding 1000V.
m)	IS:5578	Guide for marking of insulated conductors.
n)	IS:11050	Guide for forming system of marking and identification of conductors & apparatus terminal.
o)	IS:1248	Direct acting indicating analogue electrical measuring instruments and Testing accessories.
p)	IS:600	Code of practice for phosphating of iron & steel.

The board shall be metal enclosed single front, indoor, floor mounted, free standing type or wall mounting type. The panel shall be designed for a degree of protection of IP-55. However bus bar chamber shall have IP: 42 degree of protection incase bus bar rating exceed 1600 Amps. Keeping in view the operating height of the top switch 1750mm from finish floor. 400mm clear space shall be left throughout the panel at bottom. The cold rolled sheet steel will be of 2mm thick. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 3mm thickness and 50mm height.
All cutouts and covers shall be provided with synthetic rubber gaskets (preferably neoprene).
The panel shall be divided into distinct vertical sections each comprising of:

i) Complete enclosed bus bar compartment for running horizontal and vertical bus bars.

ii) Complete enclosed switchgear compartment one for each circuit for housing air circuit breaker, MCCB/MPCB with starters etc.

iii) Compartment for power and control cables of at least 300mm width covering entire height provided.

iv) The front of each compartment shall be provided with hinged single leaf door with locking facilities. Panel shall be provided with suitable lifting facilities. Isolators and MCCB/ACBs and accessories shall be of fixed / draw out type.

Each feeder shall have compartmentalized or non-compartmentalized for MCB feeders only. Ri-tall type with separate construction cable entry shall be from top/bottom (3mm thick gland plate with suitable numbers & sizes of knockout holes (as called for in schematic/ fabrication drawings) shall be provided.
The panel shall be provided with three phase buses & neutral bus bars of high conductivity electrolytic copper/Aluminium sections throughout the length of the panel & shall be adequately supported and braced to withstand the stressed due to the short circuit current of 35 KA rms. for 1 sec. Maximum temperature rise of bus bars and bus bar connection while carrying rated current shall not exceed 40 Deg.C over an ambient temperature of 50 Deg.C. The Current density of Bus Bar shall be 1.0 Amp/mm^2 for Aluminium and 1.5 Sq.mm/mm^2 for copper.
The minimum clearance in air between phases and between phases and earth for the entire run of the bus bar connections shall be 32mm minimum. Bus bars support insulators shall be made of non-hydroscopic non-combustible track resistant and high strength SMC or polyester fiberglass moulded material.
All bus bars shall be colour coded as per IS: 375.
Copper /G.I./Aluminium earth bus of suitable size shall be provided at the bottom of the panel throughout the length. Similarly suitable size of strip in each vertical section for earthing the individual equipment/accessories shall be provided and connected to main horizontal bus.
Sheet steel hinged lockable doors shall be interlocked with MCCB to prevent opening of the panel when MCCB is on position. Safety interlock with operating handle shall be provided.
Contactors shall be electromagnetic type with interrupted duty as per IS: 2959. The main contacts shall be of silver or silver alloy, provided with minimum 2 NO and 2 NC auxiliary contacts. The push button should be of shrouded type and each should be provided with 1 NO and 1 NC contact. Colour coding shall be as per IS: 6875 (Part-II).

ACB (IEC 60947-2; IS 13947)

The circuit breaker shall be of air break type in order to eliminate fire and explosion risk and shall comply with the IEC with a rupturing capacity of not less than 35 MVA at 415 volts or as specified elsewhere (The service short circuit breaking capacity shall be as specified and equal to the short circuit with stand value Ics = Icu). The breaker shall be provided with variable microprocessor based releases within built fault differentiation for integral over load, short circuit and earth fault & other protection, LED indication for type of fault, CT's for protection and measurement class and LCD display of curves and parameters. Electrical endurance without maintenance shall be greater than 2000 cycles.
Mechanical & electrical anti pumping devices shall be provided in breaker, as required.
The breaker shall have memory for logging history for type of fault, load, time & date and the Vendor shall mention in the data sheet for no. of loggings available in the breaker memory.
The breaker shall consist of a horizontal draw out pattern triple/four pole, fully interlocked, independent manual/motorized spring operated mechanism. The mechanism should be such that the circuit breaker is at all times free to open immediately. The trip coil is energized. Current carrying parts should be silver plated and suitable arcing contacts shall be provided to protect the main contact arc-chutes for each pole shall be provided and shall be lifted out for the inspection of main and arching contact.
Self-aligning cluster type isolating contacts shall be provided on breaker for interlocking protection metering and for any other purposes. The breaker should have 3 distinct positions - SERVICE/TEST/ISOLATED within the cubicle.
The ACB shall be with molded housing class II front fuse and shall be suitable for Isolation as per the annexure 7.1.2 in the standard.
Breaker shall be provided with automatic safety shutters to screen the main live contact when the breaker is withdrawn. The frame of the circuit breaker could be positively earthed when the breaker is racked into the cubicle.
The following safety arrangements shall be provided for the safety of the personnel to prevent mal-operation.

i) Interlock to prevent the truck from being withdrawn or replaced except in the fully isolated position.
ii) Interlock to prevent earth connection from being made by the earthing device except breaker is open.
iii) Interlock to prevent the breaker being closed unless it is fully raised.
iv) Interlock to prevent the breaker from being made alive without its rack in position.

3.2 MOULDED CASE CIRCUIT BREAKER (MCCB)

MCCB shall confirm to the latest IS13947-1993/IEC 60947. The Service Short Circuit Breaking Capacity (Ics at 415 VAC) should be as specified.
MCCB shall be Current Limiting and comprise of Quick Make – Quick Break switching mechanism & Double Break Contact system. The arc extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating molded case with high withstand capability against thermal and mechanical stresses.
The Service Short Circuit Breaking Capacity (Ics at 415 VAC) should be made and is the required minimum value for that feeders/ panel, however if the rating of feeder mentioned is not available, the contractor shall used next higher

rating without any extra charges. The service short circuit breaking capacity shall be equal to ultimate breaking capacity of MCCB, i.e. Ics= 100%Icu

The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection upto full rating. The remote tripping coil should be of continuous duty.

The switch shall be normally a fixed control box type heavy-duty unit.

3.3 CONTACTORS

The contactors should comply with the latest IEC947-4 and the corresponding IS13947-4 standards. They shall have UL and CSA approval. The contactors should be rated for AC3 duty at 415V and 50Hz. The contacts should be fast closing and fast opening type. The making and breaking capacity values of the contactors should be as follows (as per IEC947-4):

The contactors should be capable of frequent switching and should operate without de-rating at 600C for AC3 applications. They should be climate proof as standard .The coil of the contactor should have class H insulation to support frequent switching.

The rated voltage of the contactor shall be equal or superior at 690 V, and rated insulation voltage shall be 690 V. The rated impulse voltage of the contactor should be 8 KV.

The contactor should be modular in design with minimum inventory requirements and built in mechanically interlocked 1NO 1NC auxiliary contact up to 32A. They should be suitable for the addition of auxiliary contacts and other electrical auxiliaries without any compromise on the performance or the operation of the contactors.

The control and power terminals should be at separate **layers preferably with colour coding (black for power and white for control**)

All contactors power connection will be **finger safe (IP2X)** as standard.

3.4 NAME PLATES & LABELS

i) Panel and all modules shall be provided with prominent engraved identification plates. The module identification designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

ii) All name plates shall be of non-rusting metal or 3-ply lamicold, with white engraved lettering on black background. Inscription and lettering sizes shall be subject to employer approval.

ii) Suitable stenticilled paint marks shall be provided inside the panel/module identification of all equipments in addition to the plastic sticker labels. These labels shall be partitioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring design.

3.5 PAINTING

All steel work shall be pretreated in tanks and finally powder coated of approved shade.

3.6 WIRING

Control and protective wiring shall be done with copper conductor PVC insulated 1100 volts grade multi-stranded flexible wire of 2.5sq.mm cross section. The colour coding shall be as per latest edition of IS: 375.

Each wire shall be identified by plastic ferrule. All wire termination shall be made with type connection. Wire shall not be taped or spilled between terminal points.

Terminal blocks shall preferably by grouped according to circuit function and each terminal block group shall have at least 20% spare capacity.

Not more than one wire shall be connected to any terminal block. All doorframe of L.T. switchboard shall be earthed with bare braided copper wire.

3.7 TESTING & INSPECTION

After completion of all work at the manufacturer's works the switchboards shall be inspected and tested in presence of Purchaser's representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.

ii) Test for protective relay operation by primary or secondary injection method.

iii) Operation of all meters.

iv) Secondary wiring continuity test.

v) Insulation test with 1000 Volts megger, before and after voltage test.

vi) HV test on secondary wiring and components on which such test is permissible (2 KV for one minute)

vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.

viii) Measurement of power required for closing/trip coil of the breaker.

ix) Pick up and drop out voltages for shunt trip and closing coils.

x) CT Polarity test.

Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out along with copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before dispatch of switchboards.

3.8 DRAWINGS AND INFORMATION

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cutouts/trenches for external cables and elevations, transport sections and weights.

ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.

iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.

iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.

v) Relay wiring diagrams.

vi) Equipment List.

Vendor shall furnish required number of copies of above drawings for Purchaser's review, fabrication of switch boards shall start only after Purchaser's clearance for the same. After final review, required number of copies and reproducible shall be furnished as final certified drawings.

The information furnished shall include the following:

i) Technical literature giving complete information of the equipment.

ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.

3.9 DEVIATIONS

Deviation from specification must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

3.10 EARTHING

All electrical equipment is to be earthed by connecting two earth tapes from the frame of the equipment to a main earth ring. The earthing ring will be connected via several earth electrodes. The cable armour will be earthed through cable glands. Earthing shall be in conformity with provision of rules 32, 61, 62, 67 & 68 of Indian Electricity Rules 1956 and as per IS-3843-1966.

The following shall be earthed:

1. Transformer & D.G. Set neutrals.
2. Transformer Housing.
3. H.T. Panels.
4. Non-current carrying metallic parts of electrical equipment such as switchgear, bus ducts, rising mains, panel boards, motor control centers, power panels, distribution boards, cable trays, metal conduits, welding sockets etc.
5. Generator & motor frames.
6. All fixtures, sockets outlets, fans, switch boxes and junction boxes etc. shall be earthed with PVC insulated copper wire as specified in item of work. The earth wires ends shall be connected with solder less bottle type copper lugs.
7. The third pin of Outlets on UPS shall be provided with separate PVC insulated Cu. Wire (green with yellow stripe) as Isolated ground earth wire apart from the earthing of box.

The earth connections shall be properly made. A small copper loop to bridge the top cover of the transformer and the tank shall be provided to avoid earth fault current passing through fastened bolts, when there is a lightning surge, high voltage surge or failure of bushings.

The shop drawing for earthing system shall be prepared by the contractor and be got approved by Owner/Architect. The work shall be done in accordance with approved drawings.

All earth electrodes shall be given to a depth sufficient to reach permanently moist soil. Their location shall be marked and approval taken from Engineer-in-Charge before excavation for the same.

The earth electrodes shall be tested for earth resistance by means of a standard earth test ohms meter. All tests shall take place during the dry months, preferably after a protected dry spell.

The resistance between earthing system and the general mass of earth shall not be greater than 2 ohm.

The earth loop resistance to any point in the electrical system shall not be in excess of 1 ohms in order to ensure satisfactory operation of protective devices.

The resistance to earth shall be measured at the following: -

a) At each electrical system ground or system neutral ground.

b) At one point on each grounding system used to ground electrical equipment enclosures.

c) At one point on each grounding system used to ground wiring system enclosures such as metal conduits and cable sheaths or armoured.

All earthing conductors shall be of high conductivity copper/ G.I. and shall protect against mechanical damage. The cross-sectional area of earth conductors shall not be smaller than half that of the largest current carrying conductor.

a. Pipe Earth Electrode

G.I. pipe shall be of medium class and of the size as per NBC,2005. G.I. Pipe electrode shall be cut tappered at bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other upto 2m of length from bottom. The electrode shall be burried in the ground vertically with its top not less than 20cm below ground level.

b. Plate Earth Electrode

The plate earth electrode shall consist of copper plate or G.I. plate as per item of work. The plate electrode shall be burried in ground with its faces vertical and top not less than 2.5m below Ground level. The plate shall be filled with charcoal dust and common salt filling, extending 15cm around it on all sides.

A watering pipe of medium class G.I pipe shall be provided. The top of the pipe shall be provided with a funnel and a G.I. mesh screen for watering the earth. In the case of pipe electrode a removable plug shall be provided. This will be housed in a masonry sump (with cement plastering) of not less than 40 cm square and 40 cm deep. A C.I. frame with hinged cover of 10mm thickness and locking arrangement shall be suitably provided over the sump. The earthing lead from electrode onwards shall be suitably protected from mechanical injury by a suitable dia medium class PVC/ HDPE pipe. The overlapping in G.I. strips in joints shall be rivetted with revets and welded in approved manner. The protection pipe within ground shall be burried at least 30 cm deep (to be increased to 60cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth. In the case of plate earth electrode, two nos. 50mm x 6mm GI/Cu. Strip the earthing lead shall be securely bolted to the plate with two zinc passivated bolts, nuts, checknuts and washers. In case of pipe electrode, it shall be connected by means of a through bolt, nuts and washers and cable socket. Main earthing conductor is taken from the earth electrode with which the connection is to be made.

No earth pit shall be fixed within 2.5M of a wall of foundation. The location of the earth electrode will be such where the soil has reasonable chance of remaining moist. Effort shall be made to locate them in grass lawns or near flowerbeds or water taps. The distance between two earthing stations shall be at least 3.0 meters.

3.11 Testing and Commissioning

Testing and commissioning shall be done as per the programme/ instructions to be given by employer or authorised representative. All testing equipments necessary to carry out the tests shall be arranged by the Contractor.

Before the electrical system is made live, the Contractor shall carry out suitable tests to the satisfaction of employer or authorized representative that all equipment wiring and connections have been correctly done and are in good working condition and will operate as intended.

All tests shall be conducted in the presence of the Owner authorised representative by the Contractor and shall be notified one week before tests are to take place.

All measurements shall conform to establish minimum acceptable test values. Owner's Engineer reserves the right to approve all test results before circuit or equipments are energised for the first time.

4. <u>Specification For Lightening Protection System</u>

4.1 DIRECT LIGHTENING STRIKE PROTECTION SYSTEM: AIR TERMINALS

The direct lightening protection system should be based on advance technology Early Streamer Emission designed to intercept the lightening by anticipation an upward leader by corona effect before a lightning strike and safely convey the lightning current to earth through a known and preferred route.

The direct lightning protection system shall include components like Air termination equipment, Air terminal function test meter, transient Event Counter, mechanical support, down conductors, Surge protection and earthing system based on chemical earth pits to reduce the earth resistance.

The design of the components shall be proven with Indian conditions and traceable to field research, laboratory testing, real lightening test, fundamental analysis and statically levels of the lightening event

4.2 ESSENTIAL REQUIREMENTS

(a) A single Air Terminal must provide an umbrella protection against direct lightning strikes covering the entire area in question. The calculation of the protection radius must be based on the Rolling Sphere Theory methodology as per standards.

(b) The Air Terminal shall be non- radioactive and require no special licensing. The materials used shall be non corroding in all weather conditions i.e. rain, thunderstorm, snow, wind, dry, humid and chemical environments. It should have a central pick- up rod upper series of electrodes, Autonomous electric device generating the energy from the ambient condition through a set of 3 stelar cells environmentally protected NIMH rechargeable battery and triggering devices housed inside a weather proof stainless steel enclosure.

(c) The Air Terminal offered must not be any external source of power like peizo electric ceramics based transducer which requires wind to work.

(d) The Air Terminal should not be a static collector. It should be able to generate 35 kV to 4 kV at the tip when triggered.

(e) Tip should be capable of changing to reverse polarity using electronic triggering device based on sensing the type of lightning.

(f) The Air Terminal must be capable of handling multiple strokes of lightning currents and should be maintenance free after installation. However the functionality of the system should be measurable with a test meter. The test meter provided along with the Air-

Terminal should be able to check the functionality of the ESELC Air Terminal. Copy of technical details of the test meter must be attached with the offer.

(g) The Air Terminal must be tested in a high voltage laboratory in accordance with NFC-17-102 Appendix-C and a copy of test certificate to be attached with the offer.

(h) The Air Terminal offered must be tested in real lightning test condition by International Center for Lightning Research & Testing (ICLRT) or any Indian / International Research laboratory in the field of real lightning test using LRS and a copy of the test report must be attached with the offer. Or must be tested in the independent lab like KERI, BAZET, WUHANG, KARKOV….etc.

(i) The Air Terminal offered must be tested by Central Power Research Institute (CPRI) under min of 40 kA, 8/20 surge.

(j) A lightning strike recorder in a IP67 grade weather proof enclosure having 6 digit LCD with reset facility to be provided. Since mechanical type of counters is prone for frequent damages due to wear and tear the counter must be an electronic one.

(k) A good quality ISI mark PVC insulated flexible copper down conductor should be provided with suitable clamping/ saddling to convey the captured energy by the ESE Air Terminal to the grounding system to a maintenance free low impedance earth pit charged with chemical earth enhancing compound.

4.3 TECHNICAL SPECIFICATION

<u>Air Terminal</u>

I.	Type:	Early Streamer Emission (ESE) or controlled streamer emission Air Terminal

II.	Efficiency:	More than 98%
III.	Material used:	Chrome plated copper and stainless steel
IV.	Radius of Protection:	40 meters /53meters/79meterss/107 metres
V.	Constructional Details:	Central pick- up rods, upper and stelar cells with rechargeable battery for triggering device housed in a stainless steel weather proof and non corroding housing.
VI.	Triggering devices- type:	Electronic triggering device fitted inside the stainless steel housing.
VII.	Sensor- type:	Polarity rate of change of charge and quantity of charge Sensors arranged around the central pick- up rod internally connected with the triggering device for the fast sensing of atmosphere charge build up.
VIII.	Type of Fixing:	High mast fixed as required on base arrangement with Sound mechanical fittings & guying to take care of wind velocity of 150 Km/Hr.
IX.	Approvals/ Standards:	1. Tested in a high voltage laboratory conforming to NF C 17- 102 Appendix – C, and CPRI tested. 2. Tested in real lightning conditions or independent test labs.

Air Terminal Support

i.) The installation materials used should be non corrosive and long lasting.

ii.) The installation of the roof/ Tower should be at a height as indicated in PS clause 3.2 (VIII) from the finished roof level.

iii.) The support shall be securely bolted to the roof of the building to enable the air termination and mast system to withstand maximum locally recorded wind velocities.

Down Conductor

i.) Down conductor should be provided for each Air Termination as per ESE standard NFC 17 102 and should be connected to individual earth pits.

ii.) The down conductor should not be less than 55 Sq. mm.

iii.) Down conductor used should not be pure electrolytic copper cable with PVC insulation. Coaxial, Shielded down conductors are not acceptable.

iv.) In the final 3m to the ground and where it is exposed to human intervention, the down conductor shall be placed in a protective PVC pipe of 3mm minimum wall thickness so as to avoid mechanical damage and increase human safety.

v.) The down conductor shall be installed in accordance with the manufacturer's instruction and should not subject to bends of less than 0.5 meters radius.

vi.) The down shall be secured to the structure/ building by approved metallic fastenings at least every 1 meters.

Specification of Down Conductor

i.)	Type:	PVC insulated, pure electric flexible copper.
ii.)	Make:	Suitable ISI mark with test certificate of the cable.

iii.)	Size:	Not less than 55 sQ.mm
iv.)	Insulation:	PVC insulation.
v.)	No. of down conductors: Per Air Terminal.	Two down conductors should be provided at the Sites were the structure height is more than 28 mtr or if the horizontal length of the down conductor is more than vertical length.
vi.)	Conductor material:	Pure electrolytic Copper.

Transient Event Counter

i.)	Power Source:	Lithium NiMH battery 10 years life.
ii.)	Construction:	Polycarbonate enclosure, clear lid, IP65 rating.

Earthing

i.)	Type of grounding arrangements:	The copper earth electrode to be placed in a earth pit hole and connection to be made by stainless steel nuts and bolts/ bi metallic U clamps and sufficient quantity of eco friendly earth enhancing compound must be used. The earth enhancing compound must be certify as suitable compound by CPRI by long term test.

ii.)	Dimension of earth electrode:	Suitable technically to achieve the earth resistance <05 ohms>.
iii.)	Material for earth rod:	Manufactured from high quality copper.

iv.)	Quantity of earth enhancing:	Min. 20 kg per earth pit.
v.)	Earth resistance:	Less than 02 ohms.
vi.)	Earth enhancing compound:	Must have (Ionic, Dispersion, Hygroscopic, Expansion, Diffusion and other long lasting components.) It should not contain cyanide; level of heavy metal should be in acceptable unit.

Air terminal test meter

a) A battery operated Air Terminal test meter should be provided with each active Air Terminal for the maintenance purpose.
b) The maintenance test meter should have the facility to check the Air Terminal for its functionality.
c) It should be able to test series of component & sequence and identify a fault air terminal.
d) In case of an Air Terminal is faulty the meter should indicate it with audio as well as visual alarm.
e) Separate indication should be provided for healthy air terminal, battery status, Defective Air Terminal as well as the status of cloud sensors and corona triggering terminals.

Installation of complete system

Complete Lightning protection system including air termination, down conductors, chemical earthing etc shall be installed strictly in accordance with laid down norms, procedure and recommendations of manufacturers and by a qualified engineer/ representative of manufacturers only.

5. SPECIFICATION FOR CAPACITOR BANK & CAPACITOR CONTROL PANEL

Power factor correction capacitors shall conform in all respects to IS 2834-1964. The capacitors shall be suitable for 3 phases 415V at 50Hz. Frequency to form a bank of capacitors of desired capacity. All these units shall be connected in parallel by means of high conductivity electrolytic copper busbars of adequate current carrying capacity having S.C rating of 25 KA for 1 sec. Each capacitor bank shall be for PVC insulated aluminium conductor armoured cables. Two separate earthing terminals shall be provided for each bank for earth connection. The capacitor bank shall be housed indoor.

The capacitor bank shall be subject to routine tests as specified in relevant Indian Standard and the test certificate shall be furnished. The capacitor shall be suitable for indoor use up to 45 Deg. C over and above ambient temperature of 50degree C. The permissible overloads shall be as given below:

a) Voltage overload shall be 10% for continuous operation and 15% for 6 hours in a 24 hours cycle.

b) Current overloads 15% for continuous operation and 50% for 6 hours in a 24 hours cycle.

c) Overload of 30% continuously and 45% for 6 hours in a 24 hours cycle.

The capacitor banks shall be floor mounting type indoor housing using minimum floor space with protective guard or fencing. The capacitor bank shall be provided with 7% Detuned reactor filter to compensate third harmonics from being generated.

The insulation resistance between capacitor terminals and containers when test voltage of 500V A.C. is applied shall not be less than 50 mega ohms.

- Capacitor bank and switching equipments shall be housed in a cubicle having degree of protection IP-51 and constructed with sheet steel of minimum 2mm thickness.
- Capacitors shall be unit type having non-PCB, non-flammable non-toxic dielectric.
- Necessary discharge resistor shall be provided externally to reduce the terminal voltage to or less then 50V in 60 seconds of disconnection from supply.
- Testing shall be done as per applicable standards for shunt capacitors.

5.1 Capacitor Control Panel

The capacitor control panel shall general comprise of the following:

a) Automatic power factor correction relay.

b) Step controller with reversing motor.

c) Time delay and no-volt relays.

d) Protection MCCB / MCB.

e) Contactor (AC-3 duty) for individual capacitors of suitable rating.

f) Change over switch for either automatic operation or manual operation with push button control.

g) C.T.s with ammeter and selector switch

h) Voltmeter with selector switch.

i) Indicating lights RYB.

All the capacitors and contactors shall be interconnected with PVC insulated copper conductor wires of adequate size in a neat and acceptable manner. Three phases and neutral bus bar shall be provided in panel as required.

The above control gear, P.F. meter, Digital Microprocessor based P.F. correction relay, push button station etc. shall be housed in a sheet steel metal enclosure cubical type, free standing front operated with lockable doors. The panel shall be fabricated from MS sheet steel 2mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet steel shall be seam-welded. The panel shall be totally enclosed design completely dust tight and vermin proof. Gaskets between all adjacent units and beneath all covers shall be used to render the joints effectively.

All sheet steel material used in the construction of capacitor control panel should have undergone a rigorous rust proofing process comprising Alkaline Degreasing, descaling in dilute sulphuric acid and recognised phosphating process. The steel work should then receive two coats of primer before applying final coat of epoxy paint of approved shade.

5.2 Quality Assurance

Quality Assurance shall follow the requirement of Employer. Q.A. documents as applicable.

Q.A. involvement will commence at enquiry and follow through to composition and acceptable thus ensuring total conformity to purchaser's requirement.

6.A. SPECIFICATION OF H.T. CABLE (XLPE) (11 KV)

The cross-linked polyethylene (XLPE) cable shall be aluminium conductor PVC outer sheath steel strip armoured over inner sheath construction. XLPE cable shall conform to testing in accordance with IS: 7098 (Part-I) 1977 and (Part-II) 1973. The screening shall be done on individual cover. The armouring applied over the common covering shall be flat steel wires. Each and every length of cable shall be subjected to routine test.

The termination and jointing techniques for XLPE cables shall be by using heat shrinkable or push on cable jointing kits.

While laying underground cables in ducts care should be taken so that any underground structures such as water pipes, sewerage lines etc. are not damaged. Any telephone or other cable coming in the way shall be properly protected as per instructions of the Engineer-in-charge. The H.T. cable shall be laid at least 900mm for cable upto 33 KV (E) below the ground level in a trench 450mm wide.

Insulation tests shall be done before and after laying of cables.

6.B SPECIFICATION OF L.T. CABLES & WIRE

a) Wires

The design manufacture, testing and supply of single core **FRLS PVC** insulated 1.1 KV grade multi-stranded twisted wires under this specification shall comply with latest edition of following standards.

IS : 3961 Current rating for cables.

IS: 5831 PVC insulation and sheath of electric cables.

IS : 694 PVC insulated cables for working voltage upto and including 1100 volts.

IEC: 754(i) FRLS PVC insulated cable.

Copper multi-stranded twisted conductor FRLS PVC insulated wires shall be used in conduit as per item of work.

The wires shall be colour coded R Y B, for phases, Black for neutral and Green for earth.

Progressive automatic in line indelible, legible and sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of wire.

b) Cables

The design, manufacture, testing and supply of the cable under this specification shall comply with latest edition of following standards:

IS : 8130 Conductors for insulated electric cables and flexible cords.

IS: 7098 XLPE insulation and sheath of electric cables.

IS : 3975 Mild steel wires, strips and tapes for armouring cables.

IS : 7098 Current rating of cables.

IS: 7098 XLPE insulated (heavy duty) electric cables for working voltage upto and including 1100 volts.

IS: 424-1475 (F-3) Power cable-flammability test.

Specification for cross-linked polyethylene insulated XLPE sheathed cable for working voltage upto 1.1 KV.

Specification for XLPE insulated (heavy duty) electric cables for working voltages upto and including 1100 volts.

ASTM-D: 2863 Standard method for measuring the minimum oxygen concentration to support candle-like combustion of plastics (Oxygen Index).

ASTM-D: 2843 Standard test method for measuring the density of smoke from the burning or decomposition.

IEEE : 383 Standard for type of test Class-IE, Electric cables, feild splices and connections for power generation station.

ASTME: 662IEC:754(x) Standard test method for specific optical density of smoke generated by solid materials.

IS : 10418 Cable drums.

Testing of Cables

Cables shall be tested at factory as per requirement of IS: 7098 Part-I. The tests shall incorporate routine tests, type tests and acceptance tests. Prior to laying of cables, following tests shall be carried out:

i) Insulation test between phases and phase to earth for each length of cable before and after jointing.
On completion of cable laying work, the following test shall be conducted in the presence of Architect/Owner.

ii) Insulation resistance test (Sectional and overall) 1000/5000V depending upon the voltage grade of cable.

iii) Continuity resistance test.

iv) Sheathing continuity test.

v) Earth test.

Laying of Cable

The cable drum shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming links. At all changes in directions in horizontal & vertical places, the cable shall be bent with a radius of bend not less than 8 times the diameter of cable.

The cable of 1.1KV grade shall be laid not less than 760mm below ground level in a 460mm wide trench (throughout), where more than one cable is to be laid in the same trench; the width of the trench shall be increased.

In case the cables are laid in vertical formation due to unavoidable circumstance the depth per tier shall be increased by 200mm (minimum). Cable shall be laid in reasonably straight line, where a change in direction takes place a suitable cur-vature shall be i.e. either 12 times the dia meter of the cable or the radius of the bend shall not be less than twice the diameter of the cable drum or whichever is less. Minimum 3-meter long loop shall be provided at both sides of every straight through joint & 3 meters at each end of cable or as directed at site.

Greater care shall be exercised in handling the cable in order to avoid forming 'Kinks'. The cable drum shall in-verbally convey on wheels and the cable unrolled in right direction as indicated on the drum by the manufacturer. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains.

Where the cables are to be laid in ducts (pucca trenches) inside the building, they will have to be laid on MS rack/ on MS cable trays grouted in walls trenches. Cables sizing through floors shall be protected from mechanical damage by a steel channel to a height of one meter above the floor where cable pass through wall they shall be sleeved with PVC/steel conduit.

Where the cables are laid in open (in building) along walls, ceiling or above false ceiling, cable rack (ladder type) or cable tray shall be provided. The size of the cable tray or rack shall depend on the number of cables to pass over that rack. Cable tray/rack shall be properly supported through wall/ceiling according to the site conditions. Cable laid on tray & riser shall be neatly dressed &clamped at an interval of 1000 mm & 750mm for horizontal & vertical cable run respectively either side at each bend of cable. All power cables shall be clamped individually & control cables shall be clamped in groups of three or four cables. Clamps for multicore cables shall be fabricated of 25x3 GI flats. Single core power cable shall be laid in trefoil formation & clamped with trefoil clamps made of PVC/fibre glass.

Cable openings in wall/floor shall be sealed by the contractor suitably by hession tape & bitumen compound or by any other proven to prevent ingress of water.

After the cables are laid, these shall be tested as per IS and the results submitted to Engineer and in case the results found unsatisfactory, all the repairing/ replacing of cables will be done by the contractor free of charge.

Fire Seal System

i) All the floor/wall opening provided for cable crossing shall be sealed by fire seal system.

ii) The fire proof sealing system shall fully comply with the requirements of relevant IS/BS: 476 Part-B. The fireproof seal system shall have minimum one hour fire resistance rating.

iii) The fire proof seal system shall be physically, chemically, thermally stable and shall be mechanically secured to the masonry concrete members. The system shall be completely gas and smoke tight, **ant rodent** and anti-termite.

iv) The material used in fireproof seal system shall be non-toxic and harmless to the working personnel.

v) Type of fireproof seal system shall be foaming type or **flame mastic** type compound or approved equivalent.

After laying and jointing work is completed, high voltage test should be applied to all cables to ensure that they have not been damaged during or after the laying operation and that there is not fault in the jointing.

Cables for use on low and medium voltage system (1.1KV grade cables) should withstand for 15 minutes a pressure of 3000V DC applied between conductors and also between each conductor and sheaths. In the absence of pressure testing facilities it is sufficient to test for one minute with a 1000V insulation tester In case the test results are unsatisfactory the cost replacements and extra work of removal & laying will be made good by the contractor.

Cable shall be installed so that separation shown in the table below are observed.

HV Cable (11 KV)	-	HV Cable (11 KV)	50 mm
ELV & LV 230 V/433 V	-	ELV & LV cable 230 V/433 V Equal to the diameter of The bigger cable.	
HV cables (11 KV)	-	ELV & LV cables 230 V/433 V	300 mm
LV cables 433 V	-	Telephone/Instrument cable	350 mm
All cables	-	All hot pipe work	200 mm

CABLE TRAYS

a. **Ladder type Cable tray** – for Power Cables only

Cable trays shall be ladder type fabricated out of mild steel/slotted angles and flats of required width as per design. Bends shall be prefabricated. The cable tray shall be hot dip galvanized or primed and painted with powder coating as approved by Engineer in charge. The minimum weight of the zinc coating shall be 460 gm/sq.m and minimum thickness of coating shall not be less than 75 microns.

b. **Perforated Cable tray** – for Power Cables & Low current service both

The perforated cable trays are fabricated out of 1.6mm thick CRCA sheet steel having minimum 50mm depth, hot dip galvanized or epoxy coated of approved shade. Perforations are maximum 10mm spaced at maximum 20mm distance. The cables shall be tied with the cable tray with nylon strip/aluminium clamps/M.S. clamps as per requirements.

Suitable provision shall be made where a tray crosses expansion joints. The width of the tray shall allow for a suitable separation between cables the design shall allow for adequate bending radius for the sizes of cables. No sharp bend to be allowed in cable tray. Joints between sections shall be bolted.

The tray shall be suspended from the surface of the concrete slab by means of approved steel hangers spaced at a distance of not more than 125cms. Suitable bushes shall be provided where cables pass through apertures in the tray. Cables must be securely fixed to the tray with clamps or cable ties. In routing necessary barrier and spacing shall be maintained for cables of different voltages in case they lie side by side. Telephone cables shall cross the power cables only at about right angle and these two shall not run in close proximity. Full details of the tray shall be approved by the Site Engineer before fabrication. Earth continuity shall be maintained between each section of cable tray and each total run of tray shall be effectively bonded to the nearest earth continuity 0conductor. All nuts and bolts used shall be of galvanized steel.
Depending on the size of cable trays space of 20-33% has to be maintained for future expansion.
Cable tray is manufactured to comply with the specifications of National Electrical Code (NEC) and National Electrical Manufacturer's Association (NEMA).

. 7.SPECIFICATION FOR INTERNAL ELECTRICAL WORKS

7.1 Conducting (M.S Conduit)

All conduits shall be of heavy gauge solid drawn ERW welded manufactured out of 16 (1.6mm) gauge MS Sheet up to 32mm dia and of 14 (2 mm) gauge for sizes higher than this. Both inner and outer surfaces shall be smooth without burrs, dents and kinks. Conduits shall be black stove enameled inside and outside. The cross section of conduit shall be uniform throughout. The welding shall be uniform such that welded joints do not yield when subjected to flattening test. Welded joint shall not break when threaded or bent at an angle. Conduit shall conform to specifications of IS: 9537 (Part-II) and the capacity of conduits shall be in accordance with the standards and shall never be exceeded. The minimum size of the conduit shall be 20mm dia. Care shall be taken to ensure that all conduits are adequately protected while stored at site prior to erection and no damaged conduit shall be used.

7.2 PVC Conduit

All conduits shall be high impact rigid 2mm thickness PVC heavy duty type and shall comply with I.E.E. regulations for non-metallic conduit 2mm thick as per IS-9537/1983 (Part-III). All sections of conduit and relevant boxes shall be properly cleaned and glued by using epoxy resin glue and the proper connecting pieces. Inspection type conduit fittings such as inspection boxes, drawn boxes, fan boxes and outlet boxes shall be M.S. or otherwise mentioned. Conduit shall be terminated with adopter/PVC glands as required.

7.3 Accessories

Conduit accessories such as normal bends, unions, circular junction boxes and pull boxes, locknuts etc. shall be heavy gauge type and approved make. Conduit accessories shall conform in all respects to IS: 3837-1966 with latest amendment. Wherever several conduits are running together, adequately sized adoptable boxes common to all runs shall be used to avoid inserting inspection boxes in the individual run.
Conduits shall be laid before casting in the upper portion of a slab or otherwise, as may be instructed or in accordance with approved drawings, so as to conceal the entire run of conduits and ceiling outlet boxes. Vertical drops shall be buried in columns or walls. Wherever necessary, chases will be cut by the contractor with the help of chase cutting m/c or by hand. .
Separate conduit shall be used for:

1) Normal light, fan call bell
2) 16 A power outlets
3) Emergency Light Point
4) Fire alarm System
5) Computer Outlets
6) P.A System
7) Telephone system
8) TV Network
9) Or any other services not mentioned here.

Wiring for short extensions to outlets in hung ceiling or to vibrating equipments, motors etc. shall be installed in flexible conduits.

7.4 Switch Boxes

The switch boxes shall be zinc passivity & shall not be less than **18 SWG** thick. It will be so designed that accessories could be mounted on integral pedestals or on adjustable flat iron mounting straps with tapped holes by brass machine screw. Leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on either side of their walls. These shall be completely concealed leaving edges flush with wall surfaces. Earthing terminal inside box shall be provided.

Moulded plate switches screw less as specified in item of work shall be provided. No timber shall be used for any supports. Boxes, which come within concrete, shall be installed at the time of casting. Care shall be taken to fix the box rigidly so that its position is not shifted while concreting.

7.5 FANS(Star Rated), REGULATORS AND CLAMPS:

Ceiling fans:

Ceiling fans including their suspension shall conform to accept standards [8-2(23)] and to the following requirements:

a) Control of ceiling fan shall be through its own regulator as well as a switch in series.

b) All ceiling fans shall be wired with normal wiring to ceiling roses or to special connector boxes to which fan rod wires shall be connected and suspended from hooks or shackels with insulators between hooks and suspension rods. There shall be no joint in the suspension rod, but if joints are unavoidable then such joints shall be screwed to special couplers of 5 cm minimum length and both ends of the pipes shall touch together within the couplers, and shall in addition be secured by means of split pins; alternatively, the two pipes may be welded. The suspension rod shall be of adequate strength to withstand the dead and impact forces imposed on it. Suspension rods should preferably be procured along with the fan.

c) Fan clamps shall be of suitable design according to the nature of construction of ceiling on which these clamps are to be fitted. In all cases fan clamps shall be fabricated from new metal of suitable sizes and they shall be as close fitting as possible. Fan clamps for reinforced concrete roofs shall be buried with the casting and due care shall be taken that they shall serve the purpose. Fan clamps for wooden beams, shall be of suitable flat iron fixed on two sides of the beam and according to the size and section of the beam one or two mild steel bolts passing through the beam shall hold both flat irons together. Fan clamps for steel joints shall be fabricated from flat iron to fit rigidly to the bottom flange of the beam. Care shall be taken during fabrication that the metal does not crack while hammer to shape. Other fan clamps shall be made to suit the position, but in all cases care shall be taken to see that they are rigid and safe.

d) Canopies on top and bottom of suspension rods shall effectively conceal suspensions and connections to fan motors, respectively.

e) The lead in wire shall be of nominal cross sectional area not less than 1.5mm^2 copper and shall be protected from abrasion.

f) Unless otherwise specified, the clearance between the bottom most point of the ceiling fan and the floor shall be not less than 2.4m. The minimum clearance between the ceiling and the plane of the blades shall be not less than 300 mm.

g) Fan Speed Minimum Airflow Efficiency Requirement

Low Speed : 1,250 CFM, 155 CFM\watt

Medium Speed : 3,000 CFM, 100 CFM\watt

High Speed : 5,000 CFM, 75 CFM\watt

7.6 Exhaust Fans:

The Exhaust Fan is provided with capacitor, start and run induction motor of robust construction, totally enclosed, continuous rated type and specially designed for fan duty. Direction of rotation can be changed simply by interchanging connections of the stator windings. Conforms to I.S. Specifications No. 2612/1297 and is generally provided with class 'A' insulation; class 'E' insulation can be offered to meet special requirements. Fan motors have tow ball bearings adequately lubricated.

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

Fan Sweep	**Speed**	**Power Input**	**Current in Amps.**	**Current in Amps.**	**Sound**	**Air Displacement (in free air**

	(R.P.M)	(Watts)			Level	flow condition)
			1 - Ph.	**3 - Ph.**		
			230 V.	**400 V.**		**C.F.M**
						m^3/h
230 mm (9")	1370	40	0.18		49	440/759
300 mm (12")	920	45	0.2		46	750/1270
	1420	82	0.38	0.18	Fairly Quiet	1120/1920
380 mm (15")	920	78	0.35	0.18	Quiet	1450/2460
450 mm (18")	720	90	0.40	0.2	Quiet	2000/3400
	920	132	0.60	0.30	Fairly Quiet	2550/4340

8. SPECIFICATION FOR WIRING

All the wiring installation shall be as per IS: 732 with latest amendment. FRLS PVC insulated copper conductor cables shall be used for sub-circuit runs from the distribution boards to the points and shall be pulled into conduits. They shall be twisted copper conductors with thermoplastic FRLS insulations of 660/1100 volts grade. Colour Code for wiring shall be followed.

Looping system of wiring shall not be used, wires shall not be jointed.. No reduction of strands is permitted at terminations. No wire smaller than 1.5 sq.mm shall be used. Wherever wiring is run through trunkings or raceways, the wires emerging from individual distributions shall be bunched together with cable straps at required regular intervals. Identification ferrules indicating the circuit and DB number shall be used for submains sub-circuit wiring. The ferrules shall be provided at both end of each sub-main and sub-circuit.

Where single-phase circuits are supplied from a three phase and a neutral distribution board, no conduit shall contain the wiring fed from more than one phase. In any one room in the premises where all or part of the electrical load consists of lights, fans and/or other single phase current consuming devices, all shall be connected to the same phase of the supply. Circuits fed from distinct sources of supply or from different distribution boards or through switches or MCBs shall not be bunched in one conduit. In large areas and other situations where the load is divided between two or three phase, no two single-phase switches connected to different phase shall be mounted within one box.

No twisting connection between conductors shall be allowed.

Distribution wiring in 1100 volt grade 2x1.5 sq. mm (22/3) single core multi strand F.R.L.S PVC insulated & unsheathed twisted copper wire (approved make) in PVC casing & capping with all its accessories partly recessed in wall in PVC/conduit pipes and partly 20 mm size rigid conduit FR Precision make on surface (for ceiling points) with1x1.5 sq. mm (22/3) single core multi strand F.R.L.S PVC insulated & unsheathed copper wire to light/ceiling fan/exhaust fan/call bell points with piano type switch, call bell push, plate fixed on suitable size of G.I box of 3mm thick and 80 mm width as switch board cum Joint box flashed in wall complete with 3 nos suitable size phase, neutral cu bar with number of holes as required fixed on bakelite /hard rubber insulation of 1100v grade into the joint box (switch board) welded chairs and also arrangement for earth bus solidly jointed with board having number of standard holes for incoming/outgoing entry of polythene/PVC rigid conduit including good the damages to original finishes.

Industrial sockets shall be of moulded plastic and deeply recessed contact tubes. Visible scraping type earth terminal shall be provided. Socket shall have self-adjustable spring loaded protective cap. Socket shall have MCB/ELCB/RCCB. Maximum number of PVC insulated 1100 V grade/copper conductor cable conforming to IS: 694-1990. And followed by NBC,2005

Conduit size	**20mm**		**25mm**		**32mm**		**40mm**		**50mm**		**60mm**	
Wire size in sq.mm.	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**
1.50	7	5	12	10	20	14	-	-	-	-	-	-
2.50	6	5	10	8	18	12	-	-	-	-	-	-

Conduit size	20mm		25mm		32mm		40mm		50mm		60mm	
Wire size in sq.mm.	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**
4	4	3	7	6	12	10	-	-	-	-	-	-
6	3	2	6	5	10	8	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	-	4	3	7	6	-	-	-	-
25	-	-	-	-	3	2	5	4	8	6	9	7

Notes:

1) The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
2) The columns heads 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns heads 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.
3) Conduit sizes are the nominal external diameters.

8.1 TELEPHONE SYSTEM AND LAN WIRING

Enhanced Category 5 UTP specifications

a) The UTP shall be 4-pair, with 24 SWG solid or standard copper conductors.

The UTP-based cabling system shall have a 160 MHz channel channel bandwidth over a maximum distance of 100m (328 ft)and a channel power sum attenuation-to-crosstalk ratio (PSACR) of 9.6 dB@ 100 MHz using an interconnect or BIX cross connect configuration.

b) The UTP-based cabling system shall use matched components from a single manufacturer, certified to deliver system performance over the lifetime of the application that the cabling system was originally designed to support.

c) All component used in the UTP-based cabling system shall be warranted for a period of 25 years from date of installation against defects in materials and workmanship.

d) The UTP-based cabling system shall comply with the following standards:

Enhanced Category 5 – TIA/EIA Addendum

Category 5 – ANSI/TIA/EIA-568, TIA/EIA TSB67

Class D – CENELEC EN50173

Class D – ISO/IEC 11801

8.2 TELEPHONE TAG BLACK (TTB / IDF)

CAT-5e (enhanced) unshielded twisted pair cable in MS conduit shall be used to have modern structured cabling network for telephone system, to have latest facilities for Internet and also data cabling. All the telephone Jack must terminated on RJ-11 jacks and installed onto a dual Jack faceplate. Telephone RJ-11 Jacks must be terminated with a **BLACK** Connector/Jack.

For LAN CAT 6 UTP cables shall be used for interconnecting the RJ 45 outlets to Intermediate Switch (Hub) or directly to IT room, if the running length limit permits. These Intermediate switch shall be installed in a rack/cabinet and located in electrical room of the respective floors. Fibre Optic cable or CAT-6 UTP cable shall be used for backbone to interconnect the Intermediate switch to IT room's Server rack, as per the design requirement of the specialised Vendor. All the Data Jack must terminated on an 8 wire, 8-position Jack. Each RJ-45 Data Connection will be terminated with a **BLUE** Data Jack

Only conduit routing & wiring shall be provided by the Electrical contractor and the configuration & wiring shall be done IT Networking.

EPABX system, with latest technology will be provided. Voice Mail & Call Accounting by costing of all calls made by telephones.

A small cabinet for Low current services shall be provided at the false ceiling level at entrance of guest room, to locate all the terminal points like Tel.Tag block, tap-off box for MATV etc., for interconnecting all the low current outlets

(jacks) provided in the guest room. Each tel. outlet in guest room shall be provided a separate wire from the room tag block.

Similarly one CAT-5e wire from the floor TTB/IDF shall be provided for each Tel. Outlet proposed.

A Multi pair box Cable shall be laid from the Service gate to the Telephone switch room MDF for Direct lines from the Service provider. Some of the lines shall be bypassed to EPABX and shall be directly provided to Top management's office & Telephone operators for direct communication to outside. Rest of the lines shall be routed through EPABX for the use of patrons & staff through extensions. The following area/desk shall have direct access to outside Tel. lines:

i. Telephone Operator's room
ii. Telephone Switch room
iii. Security room
iv. Fire operator room
v. In all Lifts

8.3 DISTRIBUTION BOARDS & MCBs

a. General

Distribution boards shall be of standard make with MCBs as per approved make given. Distribution boards shall be constructed out of steel sheet all weld enclosure with double door IP42 protection and shall be powder coated. The MCBs shall be mounted on high-grade rigid insulating support and connected by electrolytic copper bus bars. Each incoming MCB isolator shall be provided with solder less cable sockets for crimping. Phase separation barriers made out of arc resistant materials shall be provided between the phases. Bus bars shall be colour coded for phase identification.

Distribution boards shall be recessed in wall. The mounting height shall not exceed 1.8 Mtr from finished floor level. Distribution board shall be provided with proper circuit identification name plate and danger sticker/plate as per requirements.

All the distribution boards shall be provided with engraved nameplates with 'lighting', 'power' or 'UPS' with DB Nos. as the case may be. Each DB shall be provided with a circuit list giving details of each circuit. All the outgoing circuit wiring shall be provided with identification ferrules giving the circuit number & phase.

Each distribution board shall have a separate neutral connection bar and a separate earth connection bar mounted within the DB each having the same number of terminals as the total number of outgoing individual circuits from the distribution board. Conduit & cable armouring shall be bonded together & connected to the distribution board earth bar.

Where oversized cables are specified due to voltage drop problems, it shall be contractors responsibility to ensure that satisfactory terminal arrangements are provided without an extra cost.

b. Earth Leakage Circuit Breaker

ELCB shall be 4 pole 415 volts 50Hz, 30-300mA sensitivity. These shall be of approved make. These shall be suitable for manual closing and opening and automatic tripping under earth fault circuit of 30-300mA as specified in item of work. The enclosure of the ELCB shall be moulded from high quality insulating material. The material shall be fire retardant, anti tracking, non-hygroscopic, impact resistant and shall with stand high temperature. All parts of switching mechanism shall be non-greasing, self-lubricating material so as to provide consistent and trouble free operation. Operation of ELCB shall be independent of mounting position and shall be trip free type. The RCCB shall be protected against nuisance tripping by protective device.

c. Miniature Circuit Breaker

1. The MCB shall be current limiting type and suitable for manual closing and opening and automatic tripping under over current and short circuit. The MCB shall also be trip free type.
2. Single pole/three pole versions shall be furnished as required.
3. The MCB shall be rated for 10 KA/15 KA fault level.
4. The MCB shall be suitable for its housing in the distribution boards and shall be suitable for connection at the outgoing side by tinned cable lugs and for bus-bars connection on the incoming side.
5. The terminal of the MCBs and the open and close conditions shall be clearly and indelibly marked.
6. The MCB shall generally conform to IS: 8828. -1996
7. The MCB shall have 20,000 electrical operations up to 63A.
8. The MCB shall have minimum power loss (Watts) as per I.S./ IEC.

8.4 EQUIPMENT AND FITTINGS

a. The type, rating, the required features, location of fixing etc. should be as per logistic and conforming I.S specification. The materials shall be of good quality acceptable to Engineer-in-Charge and to be fixed in position as directed by him.

b. Decorative fittings:
Both single and twin tube assemblies Philips make or equivalent T5 fluorescent fittings shall be of standard fittings made out of cold-drawn sheet steel, stove enameled, the box finished in gray colour and its cover plates in white colour, complete with electronics chokes and other fixtures such a holder, lamps and build wired etc as required.

c. Mirror Optics Type Fluorescent Light Fittings:
Both single and twin tube assemblies shall be of standard fittings made out of cold-drawn sheet stool, stove enameled. the box finished in gray color and its cover plates in white colour complete with Electronic chokes, holder, tube holders, lamps and earth terminal etc. with mirror reflector.

d. Bulk Head Fittings:
The fittings shall be made or pressed Aluminum body, outside finished in gray stove enameled and inside white provided with prismatic glass, covers, rubber gaskets. P.L/BC lamp holders. earthing terminal wire nets and lamps.

e. Street /Compound Light (TFL) Fittings:

The fittings shall be SON 70 Watt /150Watt/250 Watt or weatherproof type fluorescent street light fittings. The fittings shall be made of Aluminum sheet and finished outside in hammer tone gray color, stove enameled and white inside, complete with copper wire chokes, starters condensers, suitable lamp holders, lamps, assembled and wired neatly and provided with clear acrylic molded cover held by spring loaded hooks against sponge rubber gaskets to make the whole unit dust, vermin and waterproof.

f. Ceiling Fans:
The fans have to be suspended normally from the coiling. These shall be single phase AC 230 V. 50 Hz and of sizes indicated as required at site. However, if adequate vertical clearance is not available due to low ceiling, wall-bracket fans will have to be provided. Fans shall include choke type/ electronic step type regulators with hard rubber bushes, condensers, suspension couplings, terminal blocks, suitable top and bottom canopy (covers) etc. Coiling fans shall be of double ball-bearings type, conforming to IS 374 in all respects.

g. Exhaust Fans:
Heavy/ Light duty fans are required for exhaust ventilation in buildings. The fans shall be suitable for AC. single phase. 50 Hz, 230 V supply. These must be of robust construction having very low noise level.. All exhaust fans shall be impeller type with ring mounting arrangements for fixing on walls. The exhaust fans shall conform to IS: 3588 in all respects. Capacity and size of fans will be specified as per the volume of air of the room. The exhaust fans are also to be included with auto timer for it's running at regular interval.

h. Metal Clad Switch Socket Unit:
All the switch-socket units shall be made of non-corroding pressure-cast Aluminium alloy and these must be dust, vermin, water and rust proof. Switch-socket units shall be provided with interlocking arrangement for switch and plug HRC fuses, Neon--Indicator lamps, terminal blocks and pin-top The units skill be suitable for both flush and surface mounting. Switch socket units shall comply with IS 4160.

i. Installation of ceiling fan:
Unless otherwise specified, all ceiling fans shall be hung not less than 2.75 M (9 ft.) above floor. The suspension rod and clamp shall be painted with approved paint without involving extra cost.

j. Installation of Fluorescent light fitting:
In case of suspension from ceiling by two rods, each fixing to the ceiling shall be capable at sustaining at least 1.1 Kg. of dead weight. The down rods and accessories shall be painted with approved paint without involving extra cost. Unless otherwise specified, this should be suspended 2.60 M (8'-6") above floors.

k. The D.Bs shall generally be Installed at a height of 2.13 Mtrs. (7 ft) from floor level.

l. All fan clamps will have to be provided from R. C. ceiling as per PWD Specification.

m. Control switches for lights, fans, call bells; exhaust fans etc. shall be of rating 6 Amps, 230 Volt, Piano-type-flush mounted, cream colour conforming to relevant Indian Standards. Ceiling roses also shall be of 6 Amps. Rating 230 V. cream color deluxe conforming to the relevant IS - Specification. Switches of 16 Amp capacity and associated 16A six pins socket would also be required to provide facility of connection of power load up to 1 KW. Alternatively, Industrial type plug-socket board may be used In specific cases. Cable used for power load should be of suitable capacity. 230 Volt 5 amps plug socket should be 5 pin type cream clour conforming to the relevant IS specification.

n. After successful completion of the work, the final drawing/ Blue Print Plan showing the details circuit diagrams and fittings, fixtures are to be submitted along with the final bill.

9. Specification of DIESEL GENERATOR SET

9.1 Scope

This specification covers design, manufacture, assembly factory test, supply, delivery of diesel generator sets, complete in all respects with all equipment fitting and accessories for efficient and trouble free operation as specified hereunder.

9.2 Codes and Standards

The equipment shall comply with all currently applicable status, regulations and safety codes in the locality where the equipment shall be installed. Equipment shall conform to latest applicable Indian/British/ASA/ ASIM/ASME or other International Standard established to be equivalent or superior to the codes.

In the event of conflict between codes and standards referred to in the specification and requirement of this specification the latter shall govern.

9.3 Technical Details

i. Generating Sets

The generating set shall be complete with diesel engine conforming to BS:649/1958, alternator, alternator control panel, instruments, control cables and all other accessories and batteries.

The equipment shall have tropical and fungicidal treatment as per BS:CP:1014-1963 (protection of Electrical Equipment against climatic conditions).

ii. Engine

Diesel Engine of specified rating or equivalent BHP suitable for coupling with alternator. Engine shall be internal combustion type and direct injection. Electric starting suitable for diesel fuel, multi stroke of suitable rating with provision of 10% overload for 1 hour during any continuous run of 12 hours.

The speed of engine shall be 1500 rpm and the engine shall be designed to operate in the most adverse conditions.

The engine shall be water cooled. Cooling water circuit shall be fitted with corrosion resistors.

The engine shall be 6 cylinder 4 stroke type complete with the following accessories :

a) Flywheel to suit flexible coupling
b) Flexible coupling
c) Exhaust gas turbocharger/after cooler/natural aspirated
d) Heavy duty radiator with guard, cooling fan, inbuilt water circulating pump, water circuit with corrosion resistor.
e) Automatic safety control switch in case of high water temperature.
f) Automatic safety control switch in case of low lub-oil pressure.
g) Lub-oil pump, filter, cooler, piping
h) Instrument panel comprising of
    i) Water temperature gauge

ii) Lub-oil pressure gauge
iii) Lub-oil temperature gauge
iv) Starting switch with key
v) Safety control for low lub-oil pressure and high water temperature
vi) Hour meter (mech.) and RPM indicator

i) Fuel filters
j) Fuel pump
k) Hoses for fuel tank
l) Air cleaner assembly
m) Hydraulic governor
n) Self starter
o) Dynamo & regulator
p) Mechanical tachometer and running hour meter
q) Silencer residential
r) Vernier control system for speed regulation

9.4 **Starting System**

The engine shall be Electric starting with 24V starter motor and 24 volt heavy duty lead acid battery of required ampere hour (Ah) with adequate battery leads.

The D.G. sets shall be provided with suitable base frame of sturdy design made of M.S. channel with necessary reinforcement to take the load of engine, alternator and provided with anti-vibration pad.

Daily service fuel tank suitable for 990 ltr. Capacity shall be provided complete with stand, level gauge, fuel piping for supply/return, vent, filling cover drain plug, valves etc.

9.5 **Alternator**

The alternator shall be brushless type with rotating field and static excitation circuit controlled by field control unit suitably compounded for voltage and load current for a self excited self regulated system.

The alternator shall be in SP-DP enclosure, foot mounted with ball and roller bearings on end shields.

The alternator shall conform to the latest publication of IS:4722/BS:2613 and shall be suitable for tropical conditions.

The alternator shall comply with the following specifications :

Make	:	Approve make list
Rating	:	Capacity in KVA. 415V, 3 phase, 50 Hz, 0.8 pf.
Speed	:	1500 RPM
Enclosure	:	IP:23
Insulation	:	F
Excitation	:	Self excited, Self regulated with brushless system and static voltage control unit suitably compounded for voltage and current to maintain terminal voltage constant at ± 5% at all load for p.f. not less than 0.8.

Terminal Box	:	Cable box suitable for incoming PVC Cable.
Earthing studs	:	2 Nos.

The alternator shall be provided with space heater.

The alternator shall be capable of withstanding without injury single phase, 2 phase and 1/2 phase(s) to earth short circuit for a period of 3 sec. at rated speed.

9.6 **Alternator Control Panel**

The control panel shall be sheet steel enclosed and shall be dust, weather and vermin proof providing a degree of protection of IP-44. Sheet steel used shall be cold rolled and at least 2.0 mm thick and properly braced and stiffened.

Control panel shall be provided with hidden hinged door(s) with pad locking arrangement and suitable brackets/channels shall be provided for floor mounting.

All doors, removable covers and plates shall be gasketed all around with neoprene gaskets. All accessible live connections shall be shrouded and it shall be possible to change individual switches, fuses, MCCBs without danger of contact with live metal.

All live parts shall be provided with at least phase to phase and phase to earth clearances in air of 25 mm and 20 mm respectively.

Adequate interior cabling space and suitable removable cable gland plate shall be provided. Necessary number of cable glands shall be supplied and fitted on to this gland plate. Cable glands shall be screwed on type and made of brass.

Two number of earthing terminals shall be provided.

All sheet steel work shall be degressed, pickled, phosphated and then applied with two coats of zinc chromate primer and two coats of finishing synthetic enamel paint, both inside and outside of shade 631 (grey) and painted with epoxy.

The control panel shall comply with the requirements given in Annexure-I.

The control panel shall be provided with the following accessories but not limited to complete the satisfactory operation.

a) Master engine control switch for OFF/AUTO/MANUAL/TEST

b) Voltmeter 144 sq mm with selector switches for alternator/mains/ phases complete with protection fuses

c) Frequency meter 144 sq mm reed type

d) Electronic meter with digital display of : Current, Voltage, KW, KVA, KVAR, PF, KWHr, Frequency etc.

e) Current transformers required for metering

f) Ammeter144 sq. mm with CT and selector switch.

g) Mains supply, voltage monitor

h) Engine control monitor

i) Alternator voltage monitor

j) D.C. control relays, timers

k) Engine protection system for low oil lubricating pressure and high water temperature, overspeed of engine, underspeed of engine low battery voltage.

l) Window type annunciator with static relays, alarm/hooter and accept, test, reset push buttons for all functions

m) Manually operated moulded case circuit breaker of rating as mentioned in single line diagram

n) Neutral isolation contactor

o) Engine hours run counter

p) Control fuses

q) Lifting hooks

r) Gland plates

t) Neutral link

u) Earthing studs

v) Antivibration pads

w) Auxiliary relays

x) Annunciation System :
- Engine fails to start
- Generator overload
- Earth fault
- Generator prime mover failure
- Generator over voltage
- Engine overspeed
- Engine high water temp.
- Stator temp. high
- Engine low oil pressure
- Any other annunciation considered essential

9.7 **Battery and Battery charging alternator**

One lead acid 24V battery of adequate AH rating for each D.G. set shall be provided. The batteries shall be of approved make.

9.8 **Tests and Test Reports**

Type tests, acceptance tests and routine tests for D.G. sets equipment shall be carried out as per relevant standards.

The certified copies of the test certificates/reports of the above mentioned tests shall be submitted to the purchaser before despatch of equipment. The Bidder shall submit with his proposal, copies of available type test certificates of the equipment offered.

Control panel shall be subjected to the following tests :

a. High voltage test (2000 volts for 1 minute)
b. Megger test

9.9 **Drawings and Data**

As part of the proposal, the Bidder shall furnish relevant technical/descriptive literature of the D.G. set.

The Bidder shall also furnish complete filled in Data Sheet.

Control panel general arrangement drawing showing dimensioned views, cable entry location and mounting details.

Schematic wiring diagram of the control panel.

Bill of material listing equipment designation, make, type, ratings etc. of the various equipment mounted on the control panel.

9.10 TECHNICAL PARTICULARS FOR DG CONTROL PANEL

1.0	Designation	:	DG Control panel
2.0	Location	:	Indoor
3.0	Design ambient temperature	:	45°C
4.0	Type of mounting	:	Floor
5.0	Degree of protection of panel	:	IP-44
6.0	Cable entry		
6.1	Top/Bottom	:	Top/Bottom
6.2	Glands/conduit	:	Glands
7.0	Painting		
7.1	Colour finish		
	a) Outside	:	Shade 631, Epoxy coated
	b) Inside	:	Glossy white
7.2	Epoxy paint required	:	Yes
8.0	Control voltage	:	24V D.C

9.11 ACCOUSTIC ENCLOSURE

Construction Details

The Structure is fabricated using CRCA sheets of 14/16 SWG Thickness and steel members. The enclosure is fabricated on a MS Channel Frame work further strengthened by suitable cross members to make it robust and sturdy. Rock wool / Mineral wool of suitable thickness and density conforming to IS 8183 is used for acoustic insulation to reduce the sound level to 68 – 70 d b from the original sound
level of 105 – 110 d b, when measured at 1mtr.distance from the D.G. Set. The acoustic enclosure consists of following:

a) **Acoustic Insulation :**

High density **Fireproof Acoustic Enclosure Material** i.e. resin bonded rock wool / fiber glass wool (75 – 100mm thick of 64Kg/m^3 density) conforming to IS:8183 is provided on all doors and roof to absorb noise. The insulation material used is fire retardant. The insulation is covered with fiber glass cloth and is supported by perforated sheet. Sound

attenuators / downstream silencers are provided at all openings for air inlet/outlet to facilitate free air flow but to absorb sound resulting in extremely low noise level. Detachable partitions are provided inside the enclosure to attain further noise attenuation of the engine.

b) **Noise Suppressor**:

A suitably designed absorption type Hospital noise suppressor is provided which minimize the exhaust noise of the engine.

c) **Exhaust System:**

The exhaust gas is taken out through a specially designed flexible pipe, which prevents any back pressure on the engine.

d) **Thermal Insulation :**

The exhaust system and noise suppressor is provided thermal insulation by using glass wool & covering it with Aluminum sheet. This prevents it from radiating excess heat on the engine, makes it safe for the operator and enhances aesthetics.

e) **Surface Treatment :**

The enclosure is surface treated and painted with high quality polyurethane epoxy paint with prior zinc oxide primer base, which makes it weather proof and suitable for outdoor application. The paint is highly resistant to acids, alkaline, salt sprays, halogens, solvents, lubricants etc and has very good dielectric properties and is resistant to abrasion and cracking.

f) **Air Circulation & Ventilation System:**

A suitable forced air circulation and ventilation system is designed to maintain safe operating temperatures inside the enclosure. Requisite air circulation for engine aspiration combustion and cooling is provided by means of Exhaust fans or tube axial fan driven by a 3 phase squirrel cage induction motor according to need of engine.

g) **Vibration Isolation:**

The engine and alternator is mounted on Anti-Vibration Mounting pads to eliminate engine vibration.

h) **Hardware:**

Inlet and Outlet for cable, draining of lube oil and diesel etc. are provided. The doors are gasketed with high quality EPDN gaskets to avoid leakage of sound. All doors are lockable.

i) **Testing / R&D:**

The Gen set shall be thoroughly tested on load before it is dispatched from factory. The test certificate shall be submitted to the owner at the time of delivery of the equipments.

10. SPECIFICATION FOR INTELLIGENT REPORTING FIRE DETECTION SYSTEM

10.1 FIRE ALARM AND DETECTION SYSTEM

a. GENERAL

Fire alarm and detection system to be supplied by the contractor shall be complete in all respects including supply of control panels, wiring/conduit etc and shall meet requirement of applicable standards

A Fire Alarm System shall be provided to effect control over the life safety services required in the building.

The Fire Alarm System provided shall be able to tie up the following Mechanical, Electrical and Low voltage services into an integrated system.

Air Handling Units

Toilet Exhaust Fan

Smoke Evacuation System

Access control system

Lift should be shut down at fire time and should be open.

Flow switch can be integrated with the system.

The system shall be provided fire alarm initiating, annunciating and control devices.

In the event of a fire alarm, but not in a fault condition, the following action shall be performed automatically.

The system Alarm LED on the main fire alarm control panel shall flash.

Hooters in the control panel and in plant shall be sounded.

Air Handling Units on affected floors shall automatically be switched off

And simultaneously respective fire dampers shall also be closed.

Toilet exhaust fans on affected floors shall be put off.

The Panel shall be EN54 listed.

The panel shall be a Microprocessor based, Analogue addressable networkable and Intelligent.

The panel shall have all necessary provisions for interfacing with BMS, smoke evacuation system, Air handling units, firefighting equipment, elevators, access control system, and other third party systems.
In the event of CPU failure, all Signaling Loop Circuits (SLC) modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.
The system shall support a detector response time to meet world annunciation requirements of less than 1.5 seconds.
Alarm verification facility should be there.
Drift compensation facility should be there in the devices.
Devices should be able to adjust for specific sensitivity level.

b. CONTROL PANEL

The control panel shall be microprocessor based networked system designed specifically for fire, smoke control, extinguishing agent releasing (if required), integration modules for BMS or any third party control/annunciation. The panel should be wall mounted type and have a glass door with lock & keys .Suitable 20mm knockouts (18x top, 9x top rear and 2x bottom) should be there in the control panel for cable entries. The control panel shall include all required hardware, software and site specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any applications can be configured, and modified. The control panel operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.
Control panel dimension should be 475Hx450Wx125Dmm and it should also be of Steel IP30.
Fire Alarm panel shall be a multi-loop (exact number of loops as per schedule of quantity) panel with maximum loop capacity of 127 devices. It shall have a backlit 640-character liquid crystal display, individual, color coded system status LEDs, and a QWERTY style alphanumeric keypad for the field programming and control of the fire alarm system, and the provision of internal/external printer.
The panel should be advanced graphical LCD user interface with up to 240 fire zones, allows full EN54 compliance.
The control of each zone shall have following facilities for testing the circuits for fire and fault condition (i) Test
(ii) Normal
(iii) Alarm acknowledge
(iv) Fault test. And it shall be designed in such a way that audiovisual alarm is given when its position is changed from 'Normal'. The power supply to local control panels shall be derived from main control panel. The control panel shall have following visible facilities.

Mains on load
Mains failure
Battery on load
Battery discharged.

The control panel shall have following supervisory facilities.
Zone isolated
Accept – Test push button.
The control panels shall have following salient feature.
The control panel shall continuously supervise open, short and earth fault in detector cabling with auto-visual alarm distinct from fire and shall indicate fault in corresponding zone and shall also transmit the fault signal to main control panel to repeat the audio – visual alarm in control room.
Each zone shall have facility to isolate, leaving remaining zones in healthy condition to ensure that fire/fault list detected properly.
Silencing of the sounder shall not prevent fire alarm being given by any other zone simultaneously.
In case of any fault signal including fault testing which the local control panel may be giving shall not prevent a fire alarm being given, if detectors actuate at the same time.
The necessary equipment shall be provided in each control panel for connection to AHU to automatically stop as soon as fire signal is received.
Panel should be networkable up to 200 nodes.
Panel should be approved by BSI to EN54 Part 2 & 4.
Optional printer facility should be there in the panel.
Dedicated RS232 serial port for direct PC or modem connection.
4 Amp power supply and charger to EN54 part 4.
Operating Temp. 00C to 450C, Operating Humidity 95% (Max)
Mains Supply of 220V-240V, +10%, 47-63 Hz AC, 1A Max with charging current 2x2.4A DDP Temp. Compensated, power supply4x separate 24V D, 5A Off Line switched Mode, Loop current 500mA Max.
Sounder O/P 4 to 8 x 1A Programmable, Relay O/P 4x1A 30 V AC/DC (Max),10 mA, 5V (Min) Programmable, Open Collector O/P is 16 X Programmable 10 mA 30 V DC (Max).

Digital I/P 16 X Programmable, Auxiliary supply O/P 2 x 24 VDC, 500mA.

c. POWER SUPPLY

The source of electricity supply for the entire system shall be as follows (Ref. IS: 2189).

A secondary battery continuously tricle/ float charged from AC mains with facility for automatic recharging the battery sufficiently in 8 hours to supply the maximum system load at an adequate voltage for at least two hours.

The normal voltage of the battery shall be 24 Volts. The capacity of each battery shall be such that it's capable of maintaining the maximum load on the system at an adequate voltage for at least one hour plus the standby load for at least 48 hours.

Means shall be provided to prevent secondary batteries from discharging through the charging equipment in the events of its breakdown or a failure

in supply and it should give fault signal in either event. In order to minimize the risk of failure, suitable overload protective devices like fuse and circuit breakers shall be introduced. The protective devices shall be arranged to operate at suitable current higher than the maximum working current and to give on audible warning of their operation.

The protective devices shall be instead in the circuit as a points as close as possible to source of supply. The rating of fuses and the testing of circuit breakers shall be clearly and permanently indicated on the equipment.

d. DETECTORS:

General Feature's common to all detectors:

a). All fire detectors shall be compatible and should be inter changeable without requiring different mounting bases or alterations in the fire panel.

b) Detectors shall be rotary plug-in type facilitating easy removal and mounting shall be possible with hand only.

c) The detector shall be vibration an shock proof. When disassembling for cleaning purposes, its components must not be damaged by static over voltage.

d) The detector shall be ceiling mounted type.

f) All detectors shall be suitable to operate satisfactorily upto a temperature of 80 degree C, 95% RH.

g) Detectors shall not have any moving parts.

h) Response (activation) shall be clearly visible from the outside by blinking of light.

i) Reversed polarity or faulty zone wiring shall not damage the detector.

j) It shall be possible to check the sensitivity and carry out calibration at site, if required.

k) Each device shall be LPCB & EN54 approved.

l) Twin fire LED's allow 360 degree viewing.

m) Non-pulsing/pulsing facility should be there in the detectors

n) A built-in barrier shall prevent entry of insects into the sensor.

o) Ingress protection rating (Ip) should be 42

e. RATE OF RISE & FIXED TEMPERATURE HEAT DETECTOR

This type of detector shall combine the principles of rate of rise, and fixed temperature detection, which shall operate at 68 deg. C.and 90 deg. C. Rate of rise and fixed temperature detector shall sense effectively to a slow shouldering fire causing a gradual build up of heat as it shall build up to a sudden fierce fire. The rate of rise setting shall be 5 degrees per minute.

It should be electronically addressed and LPCB approved to classes A,B & C.

Twin fire LEDs allow 30 degree viewing.

Pulsing/Non-pulsing controlled from panel.

f. MANUAL CALL BUTTON STATION:

Manual stations shall be constructed of Non-frangible element fitted as standard (conforms to EN54).

Manual Call Button station should be able to status LED and fast response.

Different colour option should also be there.

All operated stations shall utilize a key type reset.

Manual call points shall be installed in such as way that one should not travel more than 30 M to reach a call point station.

It must be approved by LPCB.

It has the facility of Plug-in wiring terminals for easy installation.

g. RESPONSE INDICATOR

Response indicator of LED type shall be provided outside the rooms to indicate fire when any detector in respective room senses the fire. The design and color shall be as per interior Designer approval.

h. ADDRESSABLE SOUNDER

Hooters/Sounder shall be suitable for indoor application and should be loop powered wall sounder. All hooters shall be 24 V DC operated. The minimum sound level shall be 102 db at 10 feet. Hooter shall be EN54 listed and shall be made addressable using a control module. The hooters shall not draw power from the main panel for their operation in alarm condition. They shall be powered from a non-coded power supply and shall operate on 12-24V.

Hooters should be Loop powered and able to provide 8 volumes Levels. 51 users selected tones (all tones EN54-3 compatible) approved by LPCB.), Ingress protection rating (Ip) should be 42. Tone frequency range should be 300hz to 2850hz.

i. ISOLATOR BASE

The Sensor should be shielded from external noise.

Following feature should be existing in the Isolator base:-

Twin fire LED's allowing 360 degree viewing Variable sensitivity, electronically addressed, Non pulsing version available. Operating Voltage 17 to 41 VDC, Low power mode 12 micro, Quiescent current 39 micro, Alarm current 19mA, Digital Communication using ESP, operating Temp-10 degree C to + 50 degree C, Storage Temp Range -30 degree C to + 60 degree C, Maximum Humidity 95 % RH Non condensing (at 40 degree C), Ingress protection rating IP 42, approved by LPCB, EN-54

Part 7.

11.SPECIFICATIONS FOR P.A. SYSTEM

Sound System for Arena and Broadcast System for Complete Building, Car Calling System

11.1 Network Controller

The network control unit shall be able to routes up to 28 simultaneous audio channels, delivers power to the system, reports faults and controls the system. Audio inputs can be announcements from call stations, background music or local audio. The configuration can be done comfortably and efficiently via a PC. The network controller shall have four analog audio inputs.

11.2 Features:

Public Address and Emergency Sound System Control Unit
Fully Digital with Four Audio Inputs and Four Audio Outputs
Control and routing of 28 audio channels
Eight supervised control inputs and five control outputs
Ethernet interface for configuration, control, diagnostics, and logging
Digital storage for prerecorded messages
Stores the last 200 fault events

11.3 Controls and Indicators

Front

2 x 16-character LCD display
Rotary/push button

Back

Mains switch
Voltage selector
Interconnections
Front
Headphone output
Back
Mains input
Battery backup input
Eight control inputs
Two analog audio mic/line inputs
Two analog line audio inputs
Five control outputs (two dedicated fault)
Four analog audio line outputs
Ethernet
RS 232
Two system network connections

11.4 Wireless Handheld Microphones

Handheld transmitter shall have infrared datalink for set up with 50 mw output . It shall have built in charging contacts for charging. LCD display for frequency, group and hours of remaining battery life

The receiver shall operate in two 30 Mhz band with 1200 frequencies with infra red link through which uploading of frequency and set up of data can be done quickly. It shall have two color backlit display for easy monitoring of all operating parameters and turns from green to red when a fault condition occurs.

Specifications:

Carrier frequency range	:	650 to 680, 680 to 710, 720 to 750 760 to 790, 790 to 820, 835 to 865
Audio Bandwidth :	35 to 20000 Hz	
T.H.D.	:	<0.3% at 1 Khz
S/N ratio	:	120 dBA
Selectable channels	:	1200

11.5 Wireless Collar Microphone

Transmitter shall have infrared datalink for set up with 50 mw output . It shall have built in charging contacts for charging. LCD display for frequency, group and hours of remaining battery life

The receiver shall operate in two 30 Mhz band with 1200 frequencies with infra red link through which uploading of frequency and set up of data can be done quickly. It shall have two color backlit display for easy monitoring of all operating parameters and turns from green to red when a fault condition occurs.

Specifications :

Carrier frequency range	:	650 to 680, 680 to 710, 720 to 750 760 to 790, 790 to 820, 835 to 865
Audio Bandwidth :	35 to 20000 Hz	
T.H.D.	:	<0.3% at 1 Khz
S/N ratio	:	120 dBA
Selectable channels	:	1200

11.6 Stand Microphone

The microphone shall be a rugged dynamic cardiod goosneck microphone with good off – axis rejection for high gain before feedback and suppression of unwanted ambient noise

It shall have On/Off switch with 3 pin XLR connector.

11.7 Vocal Microphone

Microphone shall be dynamic with a choice of three output modules, varimotion diaphragm, spring steel wire mesh grill.

11.8 Call Station Basic

Call station is used to make manual or pre-recorded announcements to any pre-assigned zones or to executing pre-defined actions. The call station basic has a microphone on a flexible stem to transmit speech over the network, one push-to-talk button and a headset socket.

Features:

Redundant network connection

Power 'ON' indication

Status/fault indications

Supervision of microphone capsule

The call station keypad is used in combination with the call station basic to make manual or pre-recorded announcements to any assigned zones, to select the zones or to execute pre-defined actions.

8 freely programmable selection keys

Each key on the call station keypad has one 2-color LED

The keys of the call station keypad can be programmed for momentary or toggle operation

11.9 Car calling station

Car calling station shall have a flush mount microphone with heavy duty press to talk switch, clear busy indication, connected via CAT-5 cable.

11.10 Mixer

Frequency Response	:	+/-0.5dB, 20Hz-30kHz
THD	:	<0.009% @ 1kHz
Noise	:	-129dBu
Crosstalk		
Channel Mute	:	> 96dB
Fader Cut-off	:	>90dB
Routing Isolation	:	> 90dB
Aux Send Pots Offness	:	> 84dB
EQ		

HF	:	12kHz, +/-15dB, Q=1.5
MF	:	240Hz-6kHz, +/-15dB
LF	:	80Hz, +/-15dB, Q =1.5
Power Consumption	:	42W

11.11 Audio Signal Processor

INPUTS	:	up to 16 Analogue; electronically balanced on Phoenix/Combicon removable screw connectors.
Mic/Line Inputs	:	Nominal gain 0dB, electronically switchable up to +48dB,in +6dB steps, input impedance 3.5kOhm
Maximum input level	:	+20dBu with 0dB input gain, (+8dBu with 12dB gain)
CMRR	:	>75dB at 1KHz
Equiv. Input Noise (EIN)	:	<-128dBu typ with 150 Ohms source Phantom power: 48V nominal, selectable per input
OUTPUTS up to 16 Analogue	:	electronically balanced on Phoenix/ Combicon removable screw connectors.
Maximum Output Level	:	+19dBu
Frequency Response	:	15Hz to 20KHz (+0.5dB/-1dB)
THD	:	<0.01% (20Hz to 20KHz, +10dBu output)
Dynamic Range	:	108dB typ. (22Hz to 22KHz unweighted)
Crosstalk	:	<-75dB
		CONTROL PORTS 12 inputs and 6 outputs
Control Input Voltage	:	0 to 4.5v
Control Input Impedance	:	4.7kOhms to +5V (2-wire mode) >1MOhm (3-wire mode)
Logic Output Voltage	:	0 or +5V unloaded
Logic Output Impedance	:	440 Ohm
Logic Output Current	:	10mA source, 60mA sink
Withstanding voltage	:	80V maximum (Off)
Series Impedance	:	220 Ohms (isolated)
Mains Voltage	:	85-270V AC, 50/60Hz
Power Consumption	:	<35VA

11.12 Professional Grade CD player cum Cassette Deck

Professional Grade CD Player cum Cassette Deck comprised of combination CD Player and auto reverse cassette deck, pitch control for dance and exercise studio, continuous play CD-to-tape and tape-to-CD, independent displays for CD and tape functions

CD Player		
Digital Filter	:	4-times oversampling
Sampling frequency	:	44.1 kHz
DA converter	:	16-bit linear/channel
Frequency response	:	10Hz – 20kHz + 0.5dB
Signal to noise ratio	:	90dB
Dynamic range	:	80dB
Total harmonic distortion	:	0.02% (1kHz)
Cassette Deck		
Heads	:	Record/playback x 1 (rotary reverse),
Erase x 1		
Motor	:	DC motor
Wow and flutter	:	0.08%
Frequency response	:	50Hz – 15kHz + 3dB metal
Signal to noise ratio	:	69dB, dolby B NR ON

11.13 Remote Car Call station Interface

Remote Call station interface shall work as an interface between remote call station and main controller. It shall have built in DSP circuit for audio processing function

11.14 Three-Way Loudspeaker

Frequency Range1 (-10 dB)	:	41 Hz to 17 kHz
Frequency Response1 (±3 dB)	:	49 Hz to 15 kHz
Coverage Pattern	:	60° x 40°
Directivity Factor (Q)	:	22.4
Directivity Index (DI)	:	13.5 dB
Crossover Modes switchable	:	Tri-amp/Bi-amp (passive mid-high)
Passive Crossover2	:	6th order (36 dB/oct) Linkwitz-Riley HP & ` LP, 1.5 kHz
Transducer Power Ratings LF (4800 W peak), 100 hrs	:	1600 W (6400 W peak), 2 hrs. 1200 W
(AES)3	:	MF: 350 W (1400 W peak), 100 hrs HF: 75 W (300 W peak), 2 hrs
Long-Term System Power	:	LF: 1200 W (4800 W peak) Bi-amplified Passive Mode
Rating (IEC)4	:	M/HF: 300 W (1200 W peak), 100 hrs
Maximum SPL5	:	Tri-amp mode: LF: 128 dB-SPL cont avg (134 dB peak) MF: 135 dB-SPL cont avg (141 dB peak) HF: 135 dB-SPL cont avg (141 dB peak)
Passive mode	:	135 dB-SPL cont avg (141 dB peak)
System Sensitivity6 (1W @ 1m)	:	Passive Mode: 110 dB-SPL (mid/high section only)
Low Frequency Driver	:	2 x 2206H 300 mm (12 in) driver with 100 mm (4 in) voice coil
Nominal Impedance	:	4 ohms (2 x 8 ohms, internally wired in parallel)
Sensitivity6 (1W, 1m)	:	96 dB-SPL
Mid Frequency Driver	:	CMCD-82H cone midrange compression driver with integral 200 mm (8 in) Differential Drive® dual 75 mm (3 in) voice coil driver
Nominal Impedance	:	8 ohms
Operaional Band)	:	Sensitivity6 (1W @ 1m within 110 dB-SPL
High Frequency Driver	:	2431H, 38 mm (1.5 in) exit compression driver with 75 mm (3 in) voice coil
Nominal Impedance	:	8 ohms
Sensitivity6 (1W @ 1m)	:	116 dB-SPL

11.15 Line Array Speaker

Extended Line Array 30W column speaker with extended listening area, better intelligibility with speech and music, uniform distribution of natural sound throughout the room, excellent directivity for use in acoustically difficult reverberant applications, ultra slim housing, voice evacuation complaint as standard

Specifications :

Maximum power	:	45W
Rated power	:	30W
Sound Pressure level at 60W/1W	:	91 dB (SPL) (at 1 kHz, 1m)
Effective frequency range (-10dB)	:	190 Hz to 18 kHz
Rated input voltage	:	100V
Rated impedance	:	333 ohm

11.16 Cabinet Speaker

Cabinet speaker with 6W RMS power housed in a wooden cabinet with 200 Hz to 15 Khz frequency range, Max 97 SPL.

11.17 Horn Loudspeaker

Horn Loudspeaker shall have 15W RMS housed in weatherproof IP 65 Housing. Frequency response 500 Hz to 5 Khz. SPL 103 dB.

11.18 Amplifier

Frequency Response (at 1 watt, 20 Hz – 20 kHz)	:	±0.25 dB.
Signal to Noise Ratio below rated power (20Hz to 20 kHz)	:	105 dB A-weighted.
Total Harmonic Distortion (THD) < 0.1%. CTs 2000/3000 < 0.35%.	:	at full rated power, from 20 Hz to 20 kHz:
Damping Factor	:	10 Hz to 100 Hz: > 3000.
Crosstalk (below rated power, 20 Hz to 1 kHz)	:	> 80 dB
Common Mode Rejection (CMR) (20 Hz to 1 kHz)	:	50 dB.
DC Output Offset	:	< 2 mV.
Input Impedance (nominal) balanced, 5 kilohms unbalanced.	:	10 kilohms
Maximum Input Level dBu absolute maximum.	:	+20 dBu before input compression, +32
Load Impedance Bridge Mono: 4/8/16 ohms, 140V. (Approved Make : Crown)	:	Stereo: 2/4/8/16 ohms, 70V.

11.19 Digital Amplifier

The amplifier shall be digital class D amplifier for low power consumption and better sound quality, built in Digital signal processing like 3 section parametric equalization, automatic volume control, 2x 16 character LCD display for status information,

Specifications :

Frequency response for input	:	-3 dB at 50 hz and 20 Khz
S/N ratio for audio input	:	>87 dB
CMMR	:	> 40 dB at 1 Khz

12. SURVEILLANCE CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM

CCTV SPECIFICATION

DOME CAMERA	At least VGA Resolution
	Power over Ethernet (PoE) capability
	IR at least 10 mtr
	Vandal Resistant
EXTERNAL CAMERA	At least VGA Resolution
	Power over Ethernet (PoE) capability
	IR at least 10 mtr
	Vandal Resistant
	IP66
Cat#6 Cable	23 AWG
	LSZH
	Copper Core

Cat#6 Patch Panel	
PoESwicth	
Device Interfaces	24 10/100/1000 Mbps, PoE capable, 4 SFP
Port Standard & Functions	IEEE 802.3 10BASE-T Ethernet IEEE 802.3u 100BASE-TX Fast Ethernet IEEE 802.3ab 1000BASE-T Gigabit Ethernet IEEE 802.3af compliance IEEE 802.3x Flow Control support for Full-Duplex Mode Legacy Mode support
Switching Capacity	56Gbps
MAC Address Table	16K entries per device
MAC Address Update	Up to 256 static MAC entries Enable/ disable auto-learning of MAC addresses
Maximum 64 bytes packet forwarding rate	41Mbps

24U RACK

- Cabinet, 24U, 800mm (W) 800mm (D)
- Front Glass Door with Swing Handle Lock
- Removable Split Side Panels with slam Latch & lock
- Heavy Duty Castors & Leveling Legs
- Tray
- Fans -4 nos.
- Power Strip with at least 6no. 6Amp sockets

DISPLAY

- Diagonal Size: 32”
- Resolution: Min; 1920 x 1080 (16:9)
- Frequency: 60Hz
- Colours: 16.7 million
- Energy Star: 5.0

PATCH PANEL SPECIFICATION

Identification	I.D. Plate	PVC. Transparent color Paper
	Panel	SPCC. 1.5 mm thickness with Black (RAL 9005) color painted
RJ45 Jack	Housing	ABS, UL 94V-0.
	Contact Bracket	PC, UL 94V-2. Transparent color
RJ45 Jack Contact	Material	Phosphor Bronze with Nickel plated
	Finish	50 micro-inch Gold plated on Plug contact area
IDC	Housing	PC+Glass Fiber, UL 94V-2
	Terminal	Phosphor Bronze with Tin plated
Jack Bracket Set		ABS, UL 94V-0
Support Bar		SPCC, 1.5 mm thickness with Black (RAL 9005) color painted
PCB		FR4, UL 94V-0

SERVER SPECIFICATIONS

•32-nm Intel E5-2600 "Sandy Bridge-EP" processors featuring fast processing combined with advanced power management. These processors also feature Turbo Boost 2.0, which allows cores to operate at higher-than-stated frequencies when operating below power and thermal design points, and Data Direct I/O caching, which delivers higher bandwidth between processors and between processors and PCI connected devices.

•Enhanced virtualization with Intel Trusted Execution Technology (TXT), providing hardware-based mechanisms that help protect against software-based attacks by sectioning off application environments

•Up to 768 GB (24 DIMMs) of LRDIMMs with ECC, up to 384 GB (24 DIMMs) of DDR3 RDIMMs with ECC, up to 64 GB (16 DIMMs) of DDR3 UDIMMs with ECC, or up to 384 GB (24 DIMMs) of DDR3 HCDIMMs with ECC, including new 1.35V low-voltage DIMMs.

•A high level of energy efficiency with energy-efficient Sandy Bridge-EP processors, optional low-voltage DIMMs, an energy smart design, and IBM Active Energy Manager power monitoring and control.

•6 Gb/s controllers with hardware-based RAID 0, 1, and10 standard. Upgrades to RAID 5, 6, 50, and 60 are also available.

•Support for up to 32 1.8-inch SSD drives, 16 2.5-inch SAS/SATA/SSD drives, or 6 3.5-inch SAS/SATA drives, and an optional optical drive and tape drive. Intermixing of SAS/SATA/SSD is allowed.
•Extreme energy efficiency with optional low-voltage processors, low-voltage DIMMs, 94%-efficient power supplies, an energy smart design, counter-rotating fans, an altimeter to regulate fan rotation, and IBM Active Energy Manager power monitoring and control

•An advanced Integrated Management Module (IMM2) that enables remote control to manage, monitor, and troubleshoot servers from any location. It has an integrated video controller, a remote presence/cKVM function, and Super I/O. The IMM2 has a responsive user interface, fast power on, and high remote presence performance

•A TPM chip, which is a coprocessor that can hold cryptographic keys that protect information

•Four PCI Express 3.0 x8 slots through two riser slots standard. These slots are convertible to other configurations, including PCI-X slots with optional riser card

• Support for PCI Express and PCI-X makes the transition easier for legacy card users.
•

- Eight USB flash ports, including two internal USB ports for virtualization and security/authentication needs

- A choice of two hot-swap and redundant 80-plus platinum (94% efficient) supplies and a smart, redundant cooling design that delivers exceptional energy efficiency

- A choice of internal tape options

- Enhanced Predictive Failure Analysis, which helps decrease planned and unplanned server downtime for improved reliability and maximum utilization

- Light-Path Diagnostics, which helps speed up diagnosis of failures by providing a lighted path to problem components, minimizing maintenance expense and downtime.

- Integrated quad-port Gigabit Ethernet with the option of two 10 Gb Ethernet ports via a mezzanine card.

13. <u>SPECIFICATIONS FOR CONDUITING & WIRING FOR TELEPHONE SYSTEM</u>

13.1 GENERAL

Contractor shall supply & install conduit & wiring including Telephone Tag Blocks, telephone outlet, cover plate, outlet boxes etc. complete as required.

13.2 CONDUITING

Conduiting for telephone system shall be carried out in MS Conduit. Separate conduit shall be provided for Telephone cables. Conduiting shall be carried out as per specification above.

13.3 WIRING

Each telephone outlet shall be wired in conduit with 0.60mm dia annealed tinned copper conductor PVC insulated and PVC sheathed unarmoured cable from floorwise Telephone Tag Block. Main Telephone tag block shall be fixed on ground floor. Floorwise tag block shall be wired from Main telephone tag block with multipaired armoured 0.60mm dia annealed copper conductor PVC insulated & PVC sheathed cables.

13.4 OUTLETS

All telephone outlet shall be modular plate type accessories with RJ 11 Jack outlet. Cover plate shall match in shape & finish with other light and power accessories.

13.5 TELEPHONE DISTRIBUTION BOARD

Telephone Tag Block shall be fabricated from 1.63 mm thick M.S. Sheet duly powder coated after metal treatment. Telephone Distribution Board shall be equipped with krone type tag block of size as mentioned in BOQ. Tag block shall be double jumpering type and shall be suitable for termination of extra pair provided in wiring/ cabling of each outlet. Box shall have hinged cover and finish shall match with aesthetic finish of the building.

13.6

	EPBAX SYSTEM
Sl.No.	**Functional Requirements :**
A	The IP PBX should be fully digital & should employ Stored Program Control (SPC) using Pulse Code Modulation (PCM), confirming to latest ITU-T (earlier CCITT) standards. The system supports not only IP but also TDM giving the advantages of both the worlds.
B	The system shall be 100% non-blocking.
C	The offered system should support analog/ digital Phones and should support IP capabilities. The IP gateway should be able to support SIP. Options of wired and wireless IP phones from the same OEM as the main PBX must be available. Communication will be secure and based upon SRTP.
D	The Central Processing Unit (CPU) of IP PBX should use 32-bit microprocessor.
E	The System should have Integrated Modem on the central motherboard for remote maintenance.
F	There should be an LED indication on each card, which can help determine the state of the card.
G	The system should be suitable to accommodate both Decadic Pulse (DP) and DTMF telephones. The system should support outgoing DTMF transmission even from Digital and IP phones.
H	System should supports Digital Phones as well as IP phones. The digital Phones should offer the following features:
	- 2 x 24 Character Tiltable Display
	- Interactive Menu keys for Interactive user prompts
	- Hands free Operation
	- Upto 12 in-built Programmable Keys. For further one-touch keys, support for key module.
	- In-built USB port to connect data equipment like PC or a keyboard.
	- Adapter slots
	- 1st party TAPI compatible to support TAPI based Dialer applications like Microsoft outlook dialer.

I	Apart from the IP support on the IP PBX, it should also work with any type of public exchange or similar network to which it will be connected without requiring any modification in networks. It should be possible to network with exchanges of different makes / technologies using either E&M lines or ISDN BRI/PRI lines.			
J	The system should be ventilated by conventional airflow. No cooling fans should be used in any part of the IP PBX cabinet.			
K	The equipment should have flexibility to add/delete/modify service features and other facilities without requiring extensive modification. These changes should be possible via a Digital phone.			
L	The system should have emergency transfer facility to automatically route the C.O. lines to predefined extensions in case of power failure.			
M	The system should support simultaneous voice and data capability over the same single pair telephone cable in (2B+D) ISDN BRI format. The following voice & data terminals should be supported.			
	- ISDN terminals such as ISDN-PC card			
	- ISDN FAX (G4).			
	- Video Conferencing Equipment. The system shall also support PRI ISDN in (30B+D) Format.			
N	The system should support inbuilt Voice processing applications such as Voice Mail, Auto attendant.			
O	The system shall support Integrated Cordless Solution based on the DECT (Digital Enhanced Cordless Telephony) technology. The system should support upto 16 Base stations & 64 handsets. Direct Base station connectivity to the control Board			
P	System should support Roaming & Handover (i.e. the call should not get cut when the DECT user moves from one base station cell area to another Base station cell area)			
	Speech path	Digital PCM-TDM with VoIP support		
	Control technology	Stored Program Control (SPC)		
	System capacity	upto 388 analog/ digital users and 500 IP users		
	Signal conditions- DTMF	As per CCITT Rec.		
	Decadic dial Inter Digit Interval	10 PPS, 800msec		
	Pulse ratio	Programmable		
	FLASH time	40 msec. to 1620 m sec		
	E&M signaling	Type I - V, Immediate start, Wink start, delay dialing, Seizure acknowledgment, start		
	Environmental conditions:			
	Temperature	from +5 to + 40 0C		
	Relative Humidity	5% to 85 % RH non condensing		
	Power Consumption	Less than 1000 watts		

14. <u>SPECIFICATION FOR NURSE CALL SYSTEM</u>

Nurses Call System: The system includes patient call switches, Nurse Presence Module, Display Unit, Corridor lamps, Bath Room Patient Call switches, Nurse Station, Zone controller etc

A communications terminal for hospitals, capable of supporting multimedia applications, which unites several traditional systems in a single unit, is to be supplied. For future-oriented reasons this platform must be created using IP technology, and must completely support the TCP/IP, UDP and FTP protocols

CODES AND STANDARDS

Execute and complete the work to recognized industry best standards and in full compliance with specifications. The following and any other relevant International /national codes, standards and recommendations shall apply in addition to the regulatory/statutory requirements to all aspects of the Contract;

a. DIN VDE 0834 Part 1 and Part 2: 2000-04;
Part 1: Requirements for equipment, erection and operation
Part 2: Environmental conditions and electromagnetic compatibility.

b. DIN EN 793 Special requirements for the security of medical supply units.

c. DIN EN 60601-1 Medical electrical equipment.
Part 1: General requirements for basic safety and essential performance.

d. DIN EN 60601-1-1 Medical electrical equipment.
Part 1-1: General requirements for safety; Collateral standard: Safety requirements for medical electrical systems.

e. EN 61000-6-2 Electromagnetic compatibility (EMC)
Part 6-2: Generic standards - Immunity for industrial environments.

f. EN 61000-6-3 Electromagnetic compatibility (EMC) -
Part 6-3: Generic standards - Emission standard for residential, commercial and light industrial environments.

g. DIN VDE 0100 Erection of power installations, with rated voltages up to 1000 V; chronological data of installation specifications.

h. DIN VDE 0107 High voltage power installations in medical buildings with stationary or outpatient areas.

i. **JCI Guidelines:** The location of Nurse Call Devices shall be in compliance with table 2.1.4 of clause 2, 1; "Common Elements for Hospitals."

15. SPECIFICATION OF HEAT VENTILATION & AIR CONDITIONING

15.1 DESIGN CONSIDERATIONS:

a. The option proposed to be adopted for this project, will be planned and selected for:
b. Low capital cost.
c. Energy efficient throughout the varying load patterns.
d. Providing required Indoor air quality (IAQ) with reduced operating cost.
e. Maximum flexibility of operation.
f. Use of highly responsive control system (BMS) to optimize system functioning.

15.2 CAPITAL COST

a. The selection of equipment is designed to achieve the lowest capital cost consistent with energy efficient modern technology.

b. The choice of equipment and specifications will provide the best possible system at a reasonable price.

15.3 ENERGY EFFICIENT

a. The air conditioning systems operate between a minimum demand of 40% and up to a maximum demand of 95% for a major part of the year.

b. Hence, the selection proposed is such that the overall power requirement remains consistent with the demand, avoiding all possible waste.

15.4 INDOOR AIR QUALITY

a. ASHRAE (USA) standard call for maintaining a desirable Indoor Air quality (IAQ) in a tightly sealed building.

b. This is to prevent sickness syndrome in people who occupy these buildings for a long period. This will also help to control the concentration of harmful bacteria to provide a comfortable environment, to save energy, to prevent exhilaration / infiltration of pathogens etc.

15.5 FLEXIBILITY

a. There will be multiple chillers, each with their own pumps.

b. Each chiller will have separate pumps. Therefore, the number of pumps operating at any time will not be more than the number of chillers, thereby saving energy.

c. In addition each floor will have independent AHU/FCU.

d. This will ensure that the equipment in operations is as per demand without any wastage of power.

15.6 CENTRAL SYSTEM AND DUCT ABLE SPLIT, SPLIT TYPE AND DIRECT WINDOW

a. There are several types of chilling units available if designed centralized. However, for this application the following type is considered appropriate.

- Air Cooled Type

15.7. <u>BASIS OF DESIGN</u>

a. Design Parameters

Outside Conditions	Summer :	42.2°C DB; 25.5°C WB (20% RH)
	Monsoon :	32.2°C DB; 28.3°CWB (60% RH)
	Winter :	10°C DB; 6.6°CWB (60% RH)
Inside Conditions (Summer & Winter)		: As per Table – I RH not exceeding 55% in all areas. For OT's Relative Humidity shall be max. 50%.
Outdoor Air (Fresh Air)		: As per Table – I & III
Lighting Load		: As per Table – II
Equipment Load		: As per Table – II
Occupancy		: As per Table – II

b. U factor and solar heat gain co-efficient (SHGC) used in heat load calculations:

- U factor for glass = 6.3 W/m² k
  = 1.1 Btu/ sq ft. h ˚F
- SHGC for glass = 0.56
- U factor for Wall = 2.05 W/m² k
  = 0.36 Btu/ sq ft. h ˚F

15.8. FRESH AIR IS CONSIDERED BASED ON ASHRAE 62.1. 2007.

a. **<u>Hours of Operation</u>** 18 hours per day

b. **<u>Roof Insulation</u>** All exposed roof shall be insulated with 50 mm thick PUF or approved equal insulation

c. **<u>Exposed Glazing</u>** All windows will have single heat reflecting glass with venetian blind

15.9. REFERENCES FOR DESIGN PARAMETERS:

S.N.	Design Parameters	References
1.	Outside Conditions	ISHRAE-2007
2.	Glass U-factor	HVAC Handbook
3.	Wall U-factor	HVAC Handbook
4.	SHGC	HVAC Handbook
5.	Fresh Air	ASHRAE-62.1-2007
6.	Ventilation rate (ACPH)	NBC-2005

Table: I

SL No	Function Space	**Pressure Relationship to Adjacent Areas**	**Minimum Air Changes of Outdoor Air per Hour**	**Air Exhausted Directly to Outdoors**	**Air Recirculated Within Room Units**	**Inside Design Temp (ºC)**
1	Operating room (25% Fresh Air)	Positive	As per code	Yes	Partially	21
2	ICU / ITU Surgery	Positive	As per code	Yes	Partially	22
3	MRI, Radiograph & Fluoroscopy Room					
4	Pre / Post Operative	Positive	As per code	Yes	Yes	22
5	Minor OT (25% Fresh Air)	Positive	As per code	Yes	Yes	22
6	Recovery	Positive	As per code	Yes	Yes	22
7	Blood Bank Room	Positive	As per code	No	Yes	21
8	Ultrasonography / Clinical Pathology / Histo Pathology / Serology / Histology / Microbiology / Biochemistry	Negative	As per code	No	Yes	24
9	Minor Surgery & Treatment room	Negative	As per code	No	Yes	22
10	Radiology rooms	Negative e	As per code	Yes	Yes	22
11	CT Scan / MRI	Negative	As per code	No	Yes	24
12	Dressing Room	Negative	As per code	No	Yes	24
13	Endoscopy Room	Negative	As per code	No	Yes	24
14	Audiometric Room	Negative	As per code	No	Yes	24

Table: II

S.N	**Description**	**Light Load (W/Sqft)**	**Equipment Load (W/Sqft)**	**Occupancy (Sqft / Person)**
1	Operation Theatre / Minor OT	As per actual design	As per actual design	As per given architectural plan
2	ICU / ITU Surgery	As per actual design	As per actual design	As per given architectural plan
3	MRI, Radiograph & Fluoroscopy Room	As per actual design	As per actual design	As per given architectural plan
4	Recovery Room	As per actual design	As per actual design	As per given architectural plan

5	Ultrasonography / Clinical Pathology / Histo Pathology / Serology / Histology / Microbiology / Biochemistry	As per actual design	As per actual design	As per given architectural plan
6	Instrument & Sterilization Room	As per actual design	As per actual design	As per given architectural plan
7	Minor Surgeory & Treatment Room	As per actual design	As per actual design	As per given architectural plan
8	Radiology rooms	As per actual design	As per actual design	As per given architectural plan
9	Pre / Post Operative	As per actual design	As per actual design	As per given architectural plan
10	Endoscopy	As per actual design	As per actual design	As per given architectural plan
11	CT Scan / MRI	As per actual design	As per actual design	As per given architectural plan
12	Dressing Room	As per actual design	As per actual design	As per given architectural plan
13	Medical Superintendent Room / Doctor on Duty / Dy. Asst. MS Room	As per actual design	As per actual design	As per given architectural plan
14	Mortuary	As per actual design	As per actual design	As per given architectural plan
15	Blood Bank	As per actual design	As per actual design	As per given architectural plan
16	OT Corridor	As per actual design	As per actual design	As per given architectural plan
17	Conference Room / Library	As per actual design	As per actual design	As per given architectural plan

Table: III

S.No.	Area	Cfm/Person
1	Instrument & Sterilization Room / Scrub & Dirty Wash / Change Rooms	10
2	Mortuary / OT Incharge & Reception / Nurse on Duty	10
3	Medical Superintendent Room / Doctor on Duty / Dy. Asst. MS Room	13
4	OT Corridor	6
5	Conference Room / Library	6

15.10 FRESH AIR IS

CONSIDERED BASED ON ASHRAE 62.1 2007.

a. **Hours of Operation** 18 hours per day

b. **Roof Insulation** All exposed roof shall be insulated with 50 mm thick PUF or approved equal insulation

c. **Exposed Glazing** All windows will have single heat reflecting glass with venetian blind

15.11. REFERENCES FOR DESIGN PARAMETERS:

S.N.	Design Parameters	References
1.	Outside Conditions	ISHRAE-2007
2.	Glass U-factor	HVAC Handbook
3.	Wall U-factor	HVAC Handbook
4.	SHGC	HVAC Handbook
5.	Fresh Air	ASHRAE-62.1-2007
6.	Ventilation rate (ACPH)	NBC-2005

15.12 SYSTEM REQUIREMENT

Based on the above requirements, probable A.C. loads of the following probable areas of 5 storeyed and 10 storeyed Multi specialty & Super specialty Hospital are given below:

15.13 SYSTEM DESIGN (HIGH SIDE)

(**i**) Air-cooled Screw/ Scroll Chilling units of required TR capacity with standby facilities.

(ii) Chilled water pumps with stand by facilities

(iii) Hot water Generators of designed capacity for General Area.

(iv) Hot water Generators of designed capacity along with pumps for OTs with stand by facilities

15.14 SYSTEM DESIGN (LOW SIDE)

a. It is proposed to provide Central double skin Air handling Units for each floors of building for air conditioning the areas.

b. Each OT and other critical areas shall be fitted with Fine/HEPA filters up to efficiency of 90%.

i) The cool air from the central Air handling units will be distributed through insulated GI ducts, which would run in the corridor.

ii) Aluminum duct shall be used to distribute cool air from AHUs to Operation Theatres.

iii) A common set of insulated chilled water pipes will supply water to all the central AHUs and FCUs.

iv) Conditioned air would discharge through the extruded aluminum diffusers/Grilles.

v) It is also proposed to provide exhaust fans/blowers for the Toilets, Utility, Mechanical rooms, Kitchen area etc.

c. Insulation work would by done by Closed Cell Polyethylene material having a Thermal Conductivity 'K' not less than 0.035 W/mK at 40^0C outside ambient. Flammability and oxygen index would be in accordance with ASTM Standard.

15.15 DESIGN PARAMETERS OF PROPOSED EQUIPMENTS AND ANCILLARY WORKS

a. Hot Water Boiler

- Hot water 'In' Temperature. - 45°C (113°F)
- Hot water 'Out' Temperature. - 50°C (122°F)

b. Primary Chilled Water Pump

- Type - End Suction
- Speed - 1450 RPM
- Flow Rate - 2.4 GPM per Ton of Plant Capacity

c. Air Handling Units (Sectional)

- Unit casing - Double Skin
- Fan Outlet velocity - Shall not exceed 1800 FPM (9.1 m/s)
- Speed of Fan - Speed not exceed 1400 RPM
- Cooling Coil tube Thickness - Not less than 0.5 mm
- Tube Outer dia. - Not Less than 12 mm
- Air velocity across the filters - Shall not exceed 500 FPM (2.5 m/s)
- Air Velocity across the cooling coil - Design at 500 FPM (2.5 m/s) And shall not exceed 550 FPM (2.8 m/s)

d. Ventilation System

i. Axial Flow Fans

- Static Pressure - 30 MMWG
- Type of Motor - TEFC

ii. Centrifugal Blowers

- Type - DIDW/SISW
- Static Pressure - 32 MMWG
- Outlet velocity - Shall not exceed 2000 FPM (10.16 m/s)
- Inlet velocity - Shall be limited to 1000 FPM (5.08 m/s)

iii. Inline Fans

- Type - Direct driven type
- Static Pressure - 30/20 MMWG
- Electric supply - 220V/1 PH/50 Hz

iv. Duct Work

- Air velocity in ducts - Shall Not exceed 1500 FPM (7.6 m/s)
- Aspect Ratio of duct - Generally up to 1:4
- Friction Rate - 0.0065 to 0.008m/100m

15.16 SMOKE MANAGEMENT SYSTEM

a. Mechanical ventilation fans capacity shall be minimum 30 Air changes per hour (ACPH) in case of fire or during distress call.

b. However for normal exhaust system it should be 12 air changes per hour. This system will ensure proper quality of air and generally provide a clean and pollution free atmosphere.

c. The fans would start automatically through the fire protection system of the building and it shall be connected to main fire alarm system of the building. These fans shall also have an arrangement to start manually as and when required.

d. Building shall have smoke extraction air mechanical fans. Exhaust ducts shall be provided at ceiling level.

e. The capacity of mechanical exhaust and make up air fans capacity shall be of 10-12 air changes per hour. The fans would start automatically through the fire protection system of the building and it shall be connected to main fire alarm system of the building. These fans shall also have an arrangement to start manually as and when required.

f. It is proposed to provide separate metallic ducts for air conditioning purpose for supply and return air to the air handling units (AHUs) room. Escape routes like staircases, common corridors, lift lobbies, etc., shall not be used as return air passage.

g. There shall be separate ducts and AHUs for each compartment and AHUs shall be switched off automatically when automatic fire alarm operates.

h. There shall be separate central AHU for each floor and all the ducts shall be separate for each floor. All the air conditioning ducts serving main floor area, corridors, etc. shall not pass through the staircase area.

i. It is proposed to provide non-combustion material for insulation materials of air conditioning ducts and for air filters of air handling units for air conditioning purpose.

j. It is proposed to provide automatic fire dampers at the inlet of supply air ducts and the return air duct of each compartment on every floor. It shall also be provided at the fire separation wall and each duct penetration on each floor of the masonry shafts.

k. It is proposed to provide all staircases, lift wells and lift lobbies or corridors with a pressurization system to keep them free of smoke and toxic gases during fire for safe escape route.

l. A pressure difference (positive) for staircase shall be maintained of 40 Pa during emergency operation. For this mechanical fans shall be provided. Grilles shall be provided on each landing level of staircase and it will connect through metallic duct. The ducts shall be passed through designated masonry shafts.

m. The pressurization system will be interconnected with automatic fire alarm and detection system of the building.

n. Similarly, the lift wells are also provided with a pressurization system. A pressure difference (positive) for lift wells and lobby shall be maintained of 50 Pa and 30 Pa respectively. It is proposed to provide mechanical fans near the lift shaft along with G.I. ducting to connect the fans to lift well. The fans would start automatically through the fire protection system of the building.

o. All the service shafts serving two or more floors in the core of the building shall be sealed.

p. Smoke extraction fans shall have class 'H' insulation and a fire rating of 2 hours.

15.17 VENTILATION OF SERVICES AREAS LIKE, DG ROOM, SUBSTATION ETC.

a. Service areas include mechanical equipment room comprising of DG sets, LT Room, Transformer room, AC Plant room and pump room.

b. As per the National Building Code of India 2005 (NBC-2005) there shall be separate ventilation of services room i.e. DG sets, LT panel rooms, Transformer room, AC plant room, sewage plant (STP) room etc.

c. Separate mechanical fans shall be provided equivalent to 12 air changes per hour (ACPH) separately for DG room, LT panel room and Pump room as these rooms are placed inside the building. Similarly forced make up air will be provided for these areas. These fans shall be interlinked with main fire alarm and detection system of the building. The fans shall be automatically started in case of fire and there will be provision to run the fans manually as and when required. These areas shall have provided with normal exhaust fans as well to exhaust out the heat or gases equivalent to 10 - 12 air changes per hour.

d. Transformer rooms and other services areas shall be provided with exhaust fans capacity equivalent to 10 - 12 air changes per hour.

e. All type of mechanical fans proposed for smoke extraction shall be of class 'H' insulation or 2 hour fire rating.

f. Services areas shall be maintained at negative pressure to avoid / prevent heat or smoke leakages to the adjoining area.

g. There will be separate shaft air / ventilation shafts for each services area.

15.18. SPACE REQUIREMENTS

a. The Chillers and pumps would be placed on ground and AHUs would be placed at terrace level of the building.

b. All AHUs will be located above the false ceiling or in the separate rooms on each floor should be designed and should shown in Architectural drawing.

15.19. POWER REQUIREMENT

a. The HVAC system will require 3 Ph, 50 Hz, 415 V A.C. Connected load as per design;

b. The HVAC system will also require single phase, 50 Hz, 230Volt A.C for up to 1.5 ton capacity where required.

(i) HVAC Load for Hospital Block to be calculated as per area of both 5 storied and 10 storied building

15.20. REFERENCE STANDARD FOR HVAC SYSTEM

Code & Standard

The under mentioned Codes & Standard will be followed:

- **ANSI / ASHRAE.** Standard 15-1994. Safety Code for mechanical refrigeration.
- **NFPA.** National Fire Protection Association.
- **ARI.** Air conditioning and Refrigeration Institute.
- **SMACNA.** Fix and Smoke damper installation guide.
- **SMACNA.** Standards for Duct Construction.
- **ASHRAE.** Standard 60.1.2007. Ventilation for Acceptable Indoor Air Quality.

16. SPECIFICATION OF SIGNAGE

All signs, Internal, External and Road Signs shall be as per specifications given hereinafter:

16.1 INTERNAL SIGNS

16.1.1 General Specifications:

a. All text shall be as per the approved font and appropriate size which can be viewed at least from 3 meter.

b. Colour Scheme will be as per direction of the Employer.

c. Symbols shall be used as per general hospital standards wherever appropriate.

d. All signs to confirm the sizes, shapes and other specifications mentioned.

16.1.2 Location:

a. Type 1: Guide Map & Information Sign:

Non-illuminated and illuminated types, to be mounted on Walls inside the building, at strategic locations, to help public to locate the exit points in case of emergency and also to orient themselves on the respective floor.

b. Type 2: Location Identification Signs:

c. Type 3: Room Numbers:

All rooms will have a unique number. The Room Nos. will be mounted on or above the door frame.

d. Type 4: Statutory Signs:

i) Illuminated type with battery back-up mounted on Doors/Walls or suspended from the ceiling. These will be used for Fire Exit at various locations as required.

ii) Photo-Luminescent types, glow in dark: - to be mounted on Walls/suspended from ceiling inside the building. These will be required to provide Statutory messages inside the building at various locations.

e. Type 5: Warning/Prohibitory Signs:

Non-illuminated types, to be mounted on Walls/suspended from ceiling inside the building. These will be required to provide Statutory messages inside the building at various locations.

f. Type 6: Way Finding Signs: Wall Mounted/Ceiling suspended/Wall projected

Non-illuminated types, these will be mounted on Wall/suspended from the ceiling inside the building. These will require guiding the public to locate the direction towards the various facilities & areas inside the building.

g. Type 7: Doctor Directory Signs

h. Type 8: Evacuation Plan

Photo-Luminescent types, glow in dark: - to be mounted on Walls/suspended from ceiling inside the building. These will be required to provide Statutory messages inside the building at various locations

i. Type 9: Information Display Panel

Hospital will require poster and other information to be displayed which is frequently changed. The displayed frame will be provided mounted on walls to hold frequently changed information/poster.

17. DETAILS OF LIFT SPECIFICATION

Sl.no.	Passenger	Shaft Depth	Shaft Width	Pit Depth	Stop	Travel Distance
-						
1	Bed Lift	3.05	2.25	1.60	5	13.20

Sl no	Item	Details
1	Load – Kgs	1360 (20-persons)
2	Speed – mps	0.55
3	Travel – mtrs	Ground Floor to Fourth Floor and provision for another 5 floor of 3.6m floor height
4	Stops & Openings	5 Stops, 5 Openings (All openings on the same side) Provision for another 5 stop
	Travel – mtrs	Ground Floor to 9th Floor and 3.6m floor height
	Stops & Openings	10 Stops, 10 Openings (All openings on the same side)
5	Power Supply	400 Volts 3 Phase 50 Hertz. Alternating Current
6	Control	A.C. Variable Voltage Variable Frequency (with close loop) micro-processor control, gear less.
7	Operation	Duplex Full Collective (with/without Attendant)
8	Machine	Geared placed directly above the hoistway
9	Car Size (W x D x H) – mm	1300 x 2400 x 2400 – Inside Dimensions
10	Hoistway Reqd (W x D) - mm	2200 x 3000 – Finished Dimensions
11	Overhead Reqd - mm	4800
12	Pit Depth Reqd – mm	1600
13	Car Enclosure	IND-160
14	Car Panels	Stainless steel car panels in hairline finish

15	Handrails on three sides	Stainless steel mirror finish
16	Flooring	20 mm recess (Flooring -Granite)
17	Car Entrance	Protected by two speed stainless steel door in hairline finish
18	Size (W x H) – mm	1200 x 2100
19	Hoist way Entrances	Protected by two speed stainless steel doors in hairline finish
20	Door Operation	Automatic & Multi-Ray Electronic Door Detector System
21	Details	Fireman's switch at main lobby
22	signal	Overload Warning Device
23	ARD	Automatic Rescue Device with battery back up
	signal	Combined luminous, Hall Button and digital hall position indicator at all floors with up/down arrows
		Digital Car position Indicator in cars with up/down arrows
		Overload warning indicator in car
		Battery Operated Alarm Bell and emergency light in car with rechargeable dry maintenance free battery and battery charger (Battery back-up for 2 hours operation). Alarm bell to be located Main Lobby in Ground floor with all cable work for each lift
		Hall lanterns at all floors
	Other equipments	Battery operated alarm bell to be located in the lift lobby in ground floor with floor announcements in car and facility playing pre-recorded music within the cars during travel and between the period of floor announcements for lifts
		Voice Announcement System with provision for playing music etc for passenger each lift
	Fireman's switch	On ground floor main lobby for each lift
	Communication system	Intercommunication system – One hand set in each car and one master hand set in main landing with necessary flexible cabling system and accessories for each lift.

17.1 COMPLETION TESTS

A Load test

A contract load test under the supervision of the local authorities and in presence of the Owner's representative shall be carried out before the lift is put into commission. During the test the brakes, limit switches, buffers and car safety devices shall be caused to function with the contract load in the lift. The lift shall be tested for accuracy of levels at all loads in either direction and for smooth vibration less travel. The lift shall be accepted upon satisfactory completion of the contract load test and after the same are certified by the appropriate local authorities/Lift Inspector and Owner's representative

B. Other Completion Tests

Insulation resistance tests to earth of the entire electrical equipment and wiring installation are to be carried out by means of a constant pressure 500 volts testing meggar set and the test result shall not be less than 1 mega ohm.

Result of continuity test of the conduit installation and any other metal work to earth shall not be more than one ohm

The temperature of motors and associated control equipments shall be checked after a continuous run of at least one hour duration to ensure that temperature rises are within the limit

Test for speed shall be carried out and the speed shall not vary more than 10% of the specified speed under any conditions of load during ascending or descending

17.2 FEES & LICENSES

The Lift Contractor shall submit requisite application forms with necessary fees to the State Lift Inspector/Authority for permission to erect and for operation after getting the requisite forms (to be furnished by him) duly filled in and signed by the Owner. He will also liaison with the lift inspector and arrange for the provisional approval, inspection and issue of the licence by the Lift Inspector for regular use of the lifts.

The lift supplier will bring all his tools and tackles, testing apparatus at the time of inspection of Government Inspector/ Authority and he will be solely responsible for getting the lift installation approved/passed by the lift inspector/Authority

Statutory fees will be paid by the employer

The contractor shall undertake comprehensive maintenance of the equipments installed under this contract for a minimum period of 12 months from the date of completion of the work.

18.<u>SPECIFICATION OF PUMP MOTOR FOR WATER SUPPLY & SWEAGE</u>

18.1 MOTOR DRIVEN DRY PIT PUMPS [FOR CLEAR WATER]

End suction type, horizontally mounted centrifugal pump each capable to deliver the rated discharge of clear water. The pump should be coupled to a suitably TEFC electric motor mounted on a common base frame and anti-vibration pads/sheets, coupling, coupling guard and fixing stainless steel bolts etc. Motor HP to be suitably selected to suit discharge at duty point. The characteristic should have a wide range so that the pump does not fail at lower heads. Pump is to be selected with a minimum efficiency of 65%. The vendor has to select the best efficiency pump from the vendor list

The material of construction of pump shall be all stainless steel [minimum AISI 304] complete with body, housing, impeller & shaft of stainless steel. The base frame also shall be fabricated stainless steel**(nickel alloy bars)** with minimum 5 mm thickness of angle/channel sections & 4 mm thickness of sheets. All nuts / bolts / washers shall be of stainless steel. Gland packing shall be graphite asbestos

The material of construction of motor shall be cast iron housing, pressed stamped internals, copper windings. The motor shall be TEFC, squirrel cage induction type, IP55 rated with Class 'F' insulation & Class 'B' temperature rise, continuous rated for ambient of 50˚ C. motor efficiency should not be less than 87%. This motor will be mounted on the common stainless steel base frame. The motor will be coupled to the pump with a love joy flexible coupling

Arrangement to drain off gland packing leakage shall be provided with suitable funnel & PVC pipe of 32 mm Ø.

For close coupled mono block pump sets, the material of construction will remain the same as for dry pit pumps mentioned above but instead of gland packing there should be a mechanical seal as per manufacturers' standard. The efficiencies of pump & motor should be minimum as mentioned before

In both cases of pumps the rpm should not be more than 3000 [syn]. These pumps should be suitable for clear water operation of sp.gr = 1

18.2 SUBMERSIBLE CLEAR WATER PUMPS

The material construction of pump & motor shall be all stainless steel #AISI 304 or superior as per manufacturer. The motor protection shall be IP:68 and there should be a single mechanical seal. All other specifications shall be the same as mentioned in dry pit pumps. The pump must have all internal sensing devices as well as level sensing for automatic start & stops at required levels. Arrangement must be made for lifting the pumps with guide pipe or chain or wire as per manufacturers' standard. However such lifting arrangements will have to be of AISI 304

18.3 SEWAGE SUBMERSIBLE WET PIT PUMPS

Submersible sump pumps for sewage & waste water applications shall be all cast iron with double mechanical seals. Motor protection shall be IP:68. The motor shall be close coupled vertical motor, squirrel cage induction type with class 'F' insulation. Cooling will be with the liquid surrounding the motor frame outside. The pump set must have all monitoring devices for auto control & tripping, viz. winding temperature, moisture control, & level sensing to prevent any failure in operation. Arrangement must be made for lifting the pumps with guide pipe or chain or wire as per manufacturers' standard. However such lifting arrangements will have to be of AISI 304.

18.4 PUMPSET DATA SHEETS

Pump set data sheets complete with data as per manufacturer, material of construction, characteristic curves, efficiency curves, power consumption curves etc have to be provided for at least 3 manufacturers. Architect/Owner will chose the best available pump set from the data provided and this pump set will have to be provided by the contractor who is awarded the work. The rates quoted by contractor will take this into account

Please note that AISI 304 is slightly magnetic but AISI 316 is non magnetic

19. Specification of Mortuary Cooler

19.1. GENERAL DESCRIPTION Body Stores in Modular design of standard features will be six body Mortuary Cabinet as per matched requirement. Temperature range in all the cabinets are required 2 to 4^0 C. The unit is equipped with microprocessor based digital control panel which is to be operated with push buttons. For security and safe working high and low temperature alarm system is to be used. Refrigerating unit should be Hermetically sealed, Air cooled, Vibration free, Adjusted to interior temperature mounted on top or rare of cell having refrigeration with R134a or R404 refrigerant. Cooling system should be fully automatic defrost system and evaporator inside of the cell. Construction of Mortuaries Chamber are of double walled construction and made of 304 grades corrosion resistant stainless steel for insulation with high pressure injected polyurethane is to be used for minimizing thermal loss and meeting requirement of refrigeration in mortuaries. Doors are made of Painted stainless steel and fitted with external lock for security. This doors are to be situated in front and allows easy loading of Trays. This doors features lining should be in odorless robber gasket and anti condensation resistors. Internal lighting system should come with water proof fluorescents ceiling fittings and lamp which are fitted with the switch on the control panel. Digital microprocessor temp. display with LED system should be placed on the top of the Modular Cabinet. Exterior side of the 6 doors Mortuary Cooler inclusive complete refrigeration system will be 2500(W) x 2260(D) x 1750(H) mm, with six numbers handles. Body trays should be made of heavy gauge stainless steel as per I.S having dimension 2000(L) x 620(W) x 40(H) mm with handles.

20. SOLAR SYSTEM

20.1 SYSTEM DESIGN REQUIREMENTS

The type, complexity, and size of a solar water heating system is mostly determined by:

- Changes in ambient temperature and solar radiation between summer and winter.
- The changes in ambient temperature during the day-night cycle.
- The possibility of the potable water or collector fluid overheating.
- The possibility of the potable water or collector fluid freezing.

The minimum requirements of the system are determined by the amount or temperature of hot water required during winter, when a system's output and incoming water temperature are typically at their lowest. The maximum output of the system is determined by the need to prevent the water in the system from becoming too hot.
In order to heat water using solar energy, a collector, fastened to a roof or a wall facing the sun, heats working fluid that is either pumped (active system) or driven by natural convection (passive system) through it. The collector could be made of a simple glass-topped insulated box with a flat solar absorber made of sheet metal, attached to copper heat exchanger pipes and dark-colored, or a set of metal tubes surrounded by an evacuated (near vacuum) glass cylinder.

21. UPS SYSTEM

21.1 SPECIFICATION FOR THE UPS.

i) **Quality power Supply**

The UPS shall be ON-LINE double conversion with filter, stabilized and reliable voltage that is free from all mains interference (Over voltage, frequency variations, voltage drops).

ii) The battery cabinets used in the UPS shall be for longer runtime, The UPS shall have Optional filters, Isolation transformer module, LCD-based remote control panel, LED-based remote control panel & Communication software "professional" version.

iii) **The Operating mode of UPS**

It should operate in on-line operating mode as follows.

- **Economy Mode**: The UPS should use Line Interactive technology, i.e. the load is powered from the mains; the energy consumption is reduced with a subsequent improvement in efficiency (98%).
- **Smart active mode:** The UPS should automatically selects On Line or Line Interactive operating mode according to the quality of the mains supply, by monitoring the number, frequency and type of disturbances at the mains power input.
- **Stand-by-off mode:** With the mains available the UPS should normally not powered and consequently the power consumption is almost nil. Only when the mains fails or falls outside a preset range, does the inverter take over in 200ms using power from the batteries. This mode shall be suitable for Emergency escape lighting as pr standard **EN 50171.**

iv) **The UPS shall have Expandable feature**. The units can be connected in parallel up to 8 units to increase power availability or redundancy. The system can be expanded at any time. For the expandability there shall be "Hot System Expansion" feature, the additional unit can be connected in parallel while the other units are on-line and supplying regular power to the load. The new UPS is on-line and will receive the updated information automatically.

v) **High Reliability**

The UPS should be connected in parallel up to 8 units to exponentially increase the reliability of the system.

vi) **Maximum battery care**

In the UPS there shall be an automatic battery test which shall be able to periodically check the efficiency of the batteries. The batteries should not be used during micro-interruption (40ms), as the required energy is drawn from a group of capacitor. (Battery saving).

vii) **Maximum safety for personal**

There should be a feedback protection device in the UPS to prevent any voltage back feed in the upstream distribution board, thus ensuring the maintenance personal.

viii) For Advanced communication there shall be software system which displays the most important information such as the input and output Voltage, the load applied, the remaining back-up time, etc. It should also be able to provide information even in the event of a failure, to support the fault diagnostics.

It should also contain the following hardware interfaces:

- RS232 serial port
- Dry contacts
- EPO (Emergency Power Off)

Contact for UPS shutdown using the remote emergency button.

i) To allow easy and intuitive operation of the UPS There should be Mimic Panel. This helps in accessing the most important parameters: status and alarm, control and commands, input, output, battery measurements (power, current, voltage, frequency and temperature) and settings.

ii) **Low Input Harmonic Distortion,** The UPS shall have The Power Factor Correction (PFC), standard on all modules, so that the input power factor level to 0.95 for any load percentages so that it is ideal in conjunction with motor generator or in installation with other sensitive loads. There shall be built in Active Filter designed to reduce the level of THDi to less than 4% and to increase the input power factor up to 0.99.

This Active filter shall be based on the IGBT's Technologies controlled by the Digital Signal Processor (DSP). This DSP instantly monitors and controls the inputs current absorbed by the UPS in order to eliminate the unlike harmonics and maintain the THDi less then 4%. With the effect of Active Filter the UPS can also be connected to the low loads. These active filters shall be fitted inside the UPS so that no additional footprint is required.

Less harmonics in the UPS input reduces the neutral cable size and consequently the installation cost. Also it gives maximum reliability as any failure of the optional Active Filter has no influence on the power supplied to the load; the only consequence is the increase of current harmonics level rejected to the mains, which gives maximum reliability for the load.

iii) **The input requirement of the UPS is as follows:**

Voltage	:	400 V three-phase + N
Voltage tolerance	:	± 20%+
Frequency	:	45-65 Hz
Current distortion	:	<4% with active filter
Power factor	:	0.99 with active filter

iv) **The Bypass of the UPS is as follows:**

Rated voltage	:	400 V three-phase + N
Phases number	:	3 + N
Voltage tolerance	:	± 15%
Rated frequency	:	50 Hz
Frequency tolerance	:	± 2%
By-pass	:	Static and manual for maintenance
Transfer time	:	nil

v) **The Battery for the UPS is as follows:**

Type of battery	:	maintenance-free sealed lead-acid
Battery blocks	:	12 V
Recharge time minimum	:	6 Hr

22. SPECIAL CONDITIONS

22.1 GENERAL

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The requirement offered by the contractor shall be complete in all respects. Any materials or accessories which may not have been specifically mentioned, but which are usual and necessary for the satisfactory and trouble free operation and maintenance of the equipment shall be provided without any extra cost of the purchaser. This shall also include spares for commissioning of the equipment.

22.2 The contractor shall obtain all sanctions (electrical loads, approval of drawing/ESS/D.G.'s estimator/approval of meter room etc. from the concerned authorities and permits required for the electrical installation work. All actual fee payable in this regard will be reimbursed against receipt/documentary evidence. On completion of work, the contractor shall obtain NOC from Director of Electricity Government of west Bengal .And a copy of the same shall be delivered to the Owner.

The Owner shall have full power regarding the materials or work got tested by independent agency at the electrical authority expenses in order to prove their soundness and adequacy. The contractor will rectify the defects/suggestions pointed out by independent agency through Owner at his own expenses.

The installation shall comply in all respects with the requirements of Indian Electricity Act 1910, Indian Electricity Rules (IER) 1956 and other related Laws and Regulations (for F.F. etc.) as amended up to date, there under and special requirements, if any, of the WBSEDCL etc. The bidder is liable to furnish the list of authorized licensed persons/ employed/deputed to carry out the works/perform the assigned duties to fulfill the requirement of Rule No.3 of IER 1956 as amended up to date.

22.3 DRAWINGS

i) Shop Drawings

The contractor shall prepare detailed coordinated electrical shop and working drawing indicating lighting/lighting fixtures, convenience outlets, D.G.'s, H.T., Transformer, M.V. Panel Boards/Relay Panel, PCC, DB's, Rising Mains, Cable Schedule with other relevant services and submit to the Owner for approval or the Engineer-in-Charge before commencing the work. The shop drawings shall indicate all setting out details and physical dimensions of all components with wiring and cable details including system operating write up in the system i.e. 11 KV Panel Board, Control and Relay Panel Package Substation, D.G.'s, PCC's, MCC's, cable schedule and routes, manhole trap and fixing details as well as for conduit indicating run and size of wire/cables, outlet/pull/junction boxes etc. with fixing details etc. for the above mentioned work. All work shall be carried out on the approval of these drawings. However,

approval of these drawings do not relieve the contractor of his responsibility for providing maintenance free and fool proof system including any missing component/accessories to meet with the intent of the specifications. Contractor will submit 2 prints for preliminary approval and finally six prints for distribution.

ii) Completion Drawings/As Built Drawings

On completion of the work and before issue of certificate of virtual completion, the contractor shall submit to the employer 4 sets along with soft copy of 'As Built' drawings of the work along with 01 Nos. cloth tracing originals including write up (trouble shooting, installation, operation and maintenance manual with instructions) incorporating all such changes and modifications during engineering and execution along with warrantee & guarantee certificates from manufacturers.

These drawings must provide:

- Run and size of conduit, inspection and pull boxes including routing and locations.
- Number and size of conductor in each conduit.
- Locations and rating of sockets and switches controlling the light and power outlet.
- A complete wiring diagram as installed and schematic drawings showing all connections in the complete electrical system.
- Location of outlets of various services, junction boxes, light fixtures.
- Location of all earthing stations route and size of all earthing conductors.
- Layout and particulars of all cables.
- Location and details of PCC's, MCC's, Feeder Pillars, capacitor control panels, PLC D.G. set panel, UPS panel, and relay panels with description detailed control wiring diagram.
- Location of transformer and its details and control wiring diagram.
- Location of Hume pipe/pcc ducting and manhole including HT/LT cable layout and scheduling.
- Location of D.G.'s, exhaust and auxiliary equipments with schematic drawings.
- Layout of cable trays with support and their fixing details/vertical rising.
- Location of all earthing station, route and size of all earthing conductor.
- Layout and particulars of rising mains with fixing details.

iii) Position of HT/LT Switch Boards/Transformer & D.G.'S

The recommended position of the switch boards transformer & D.G.'s as will be shown on the layout drawings will be adhered to as far as practicable.

The contractor shall submit 2 sets of samples of each type of accessories and apparatus, proposed to be used in the installation at site for approval (drawings or samples) as required shall be submitted by contractor and the choice of selection out of the approved list lies with the Owner. For all non-specified items, approval of the Owner shall be obtained prior to procurement of the same. Owner shall in no way be liable for rejection of the any material due to poor quality, poor workmanship, poor material etc.

22.4 MANUFACTURER'S INSTRUCTIONS

Where manufacturers have furnished specific instructions, relating to the material/equipments to be used on this job, covering points not specifically mentioned in this document, manufacturers' instructions should be followed.

22.5 MATERIALS AND EQUIPMENTS

All the materials and equipments shall be of the approved make and design. Unless otherwise called for any approval by Owner's Engineer-in-Charge, only the best quality materials and equipment shall be used.

22.6 GENERAL DETAILS

a. Space Heaters & Lighting.

One of more adequately rated heaters thermostatically controlled with On-Off switch and fuse shall be provided to prevent condensation in any panel compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. CFL lamp shall be provided in any panel compartment.

b. Fungistatic Varnish

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

c. Ventilation Opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

d. Degree of Protection

The enclosures of the Control Cabinets, Junction Boxes and Marshalling Boxes, Panels etc. to be installed shall provide degree of protection shall be as given below.

- Installed out door: IP-55.
- Installed indoor in air-conditioned area: IP-52.
- Installed in covered area: IP-52.
- Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP- 42.
- For L.T. switchgear (AC and DC distribution boards): IP-52.

The degree of protection shall be in accordance with IS: 13947 (Part-I)/IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted.

23.LIST OF APPROVED MAKE

Sl. NO.	ITEM	MANUFACTURER'S NAME
1	SOLAR POWER PANEL	WBREDA/THEME SOLAR SYSTEM/ SOLAR HART/ KL SOLAR COMPANY/ APOLLO SOLAR/ AVANTE GLOBAL
2	UPS SYSTEM	EPC/EMERSON/ PCI/ SOCOMAC/ NUMERIC
3	INVERTOR	LUMINOUS / MICROTEK / SU-KAM
4	AMMETER / VOLTMETER / ENERGY METER/ TRIVECTOR METER	AE / L&T/ SCHNEIDER/ SECURE
5	L.T POWER CAPACITOR	UNIVERSAL / SIEMENS / L&T / SCHNEIDER / EPCOS
6.	AMMETER / VOLTMETER / ENERGY METER/ TRIVECTOR METER/FREQUENCY METER	AE / L&T/ SCHNEIDER/ SECURE
7.	FUSES & SWITCH FUSE UNIT	SIEMENS/ ABB/ SCHNEIDER/ LEGRAND/ L&T
8.	ACB / MCCB / CONTACTOR/ SUB DISTRIBUTION BOARDS/ MINIATURE CIRCUIT BREAKERS/ EARTH LEAKAGE CIRCUIT BREAKER / RESIDUAL CURRENT CIRCUIT BREAKER	SIEMENS/ ABB/ SCHNEIDER/ LEGRAND/ L&T
9.	METAL CLAD SOCKET	SIEMENS/ LEGRAND/ BHARTIA CUTLUR HAMMER
10.	RISING MAINS	GODREJ/TRICOLITE/ VIDHYUT/ SPC ELECTROTECH
11.	LED'S LIGHT	PHILIPS/ /BAJAJ/ WIPRO/HAVELS
12.	ISOLATORS FOR MOTORS	LEGRAND/ SIEMENS/ SCHNEIDER/ ABB
13.	CHANGE OVER SWITCH	GE/ HAVELLS/ L&T/ABB
14.	CONTACTOR, TIMER, SINGLE PHASE PREVENTOR & OVER LOAD RELAY	L&T/ ABB/ SIEMENS /HAVELS
15.	METERS - DIGITAL TYPE	AE/ L&T/ RISHAB/ GE
16.	PROTECTIVE & APFC RELAYS	ASLTOM/ ASHIDA/ L&T
17.	CT'S / PT'S- DRY TYPE-EPOXY	AE / KAPPA / L&T / SCHNEIDER
18.	INDICATING LAMP / PUSH BUTTON ACTUATERS - LED CLUSTER TYPE	L&T/ SIEMENS/ BCH
19.	ROTARY SWITCHES	L&T/ KAYCEE/ BCH
20.	TERMINAL BLOCK	ELEMEX/ WAGO
21.	LT PANELS	SUDHIR / SIEMENS / L&T / LEGRAND / SCHNEIDER/GE
22.	LIGHTNING ARRESTER ESE STOMASTER TYPE	LPI (AUSTRALIA)/ LPS (FRANCE/ FM (SUDAFIX) LY COM (H.K)
23.	GAS FIRE SUSPERSSION SYSTEM	FIRE LINE/ TYCO FIRE

24.	STARTERS (A.C.)	SIEMENS / L&T / SCHNEIDER / NORTH WEST
25.	SELECTOR SWITCHES	SIEMENS / L&T / SCHNEIDER
26.	LUGS	DOWELLS/ COMET
27.	BRASS CABLE GLANDS	COMMET/ BELIGA
28.	LT POWER CABLE (ALUMINIUM/ COPPER)	UNIVERSAL/ NICCO/ POLYCAB / SKYTONE/HAVELLS
29.	CONTROL CABLE (COPPER)	UNIVERSAL/ NICCO/ POLYCAB / SKYTONE/HAVELLS
30.	HT XLPE CABLE	UNIVERSAL / RPG CABLES / NICCO/SKYTONE/ HAVELLS
31.	H.T. CABLE END TERMINATION	BIRLA 3 M/ REYCHEM/ FRONTEC
32.	1.1 KV GRADE PVC INSULATATED FRLS COPPER FLEXIBLE WIRE UP TO 10 SQ.MM	HAVELLS/GLOSTER/FINOLEX/MESCAB/POLYCAB
33.	MS CONDUIT / GI CONDUIT (ISI MARKED)	BEC/ AKG / ATUL
34.	PVC CONDUIT (ISI MARKED)	BEC/ POLYPACK/ AKG /ATUL
35.	PVC INSULATED COPPER CONDUCTOR FRLS WIRE	FINOLEX / HAVELLS/ SKYTONE
36.	PLATE TYPE - SWITCHES / SOCKETS / TV & TELEPHONE SOCKETS AND ALL OTHER WIRING ACCESSORIES	ANCHOR-ROMA/SIEMENS/ABB/HAVELS
37.	ACCESSORIES FOR METALIC / GI CONDUIT (ISI MARKED)	SHRMA STEEL CORPORATION / PRAKASH ENGINEERING WORKS / SUPER SALES CORPORATION
38.	PVC INSULATION TAPE	STEEL GRIP/ ANCHOR
39.	PHENOL LAMINATED SHEET	HYLAM / FORMICA
40.	RACEWAYS & CABLE TRAY	PILCO/ SLOTCO/ VENUS/ RICCO
41.	LIGHTING DBS & MCBS	SIEMENS/LEYGRAND/HAVELS/ABB
42.	WIRE MESH CABLE TRAY, G.I. CABLE TRAY (LADDER TYPE)	LEGRAND / OBO
43.	MCB,10KA	LEGRAND (MDS)/ SIEMENS/ HAGER/HAVELS
44.	DISTRIBUTION BOARD	LEGRAND (MDS)/ SIEMENS/ HAGER/HAVELS
45.	CT. / PT.	AE / KAPPA / L&T / SCHNEIDER
46.	LIGHTING FIXTURES & FANS	PHILIPS/HAVELS/GE/BAJAJ
47.	EXHAUST FANS	EPC/BAJAJ/ CROMPTON
48.	BULK HEAD FITTINGS	BAJAJ/ CROMPTON/ PHILIPS/ WIPRO/HAVELS
49.	EXHAUST FANS / CEILING FAN / WALL MOUNTED FAN	CROMPTON/ POLAR/ ALMONARD/ HAVELLS/ USHA
50.	LIGHTING FIXTURES	PHILIPS/ BAJAJ/ WIPRO ./HAVELS
51.	LIGHTING CONTROL SYSTEM	SCHNIDER/ PHILIPS/ LUTRON
52.	LIGHTNING PROTECTION G-3	SGI / INDELEC / ERICO
53.	SMOKE DETECTORS	NOTIFIER/ HONEYWELL(XLS-3000)/ SIEMENS/COOPER/RAVEL
54.	HEAT DETECTORS	NOIFIER/ HONEYWELL(XLS-3000)/ SIEMENS/RAVEL
55.	MANUAL CALL BOX	HONEYWELL(XLS-3000)/ SIEMENS/RAVEL
56.	HOOTER/ SOUNDER	HONEYWELL(XLS-3000)/ SIEMENS/RAVEL
57.	RESPONSE INDICATOR	HONEYWELL(XLS-3000)/ SIEMENS/RAVEL
58.	FIRE PANEL	HONEYWELL(XLS-3000)/ SIEMENS/RAVEL
59.	PA AMPLIFIER/ PA SPEAKERS	BOSE/ PHILIPS/ AHUJA
60	MICROPROCESSOR FIRE CONTROL PANEL	HONEYWELL(XLS-3000)/ SIEMENS/RAVEL
61.	LINE MATCHING TRANSFORMER	BOSE/ PHILIPS/ AHUJA
62.	GOOSE NECK MIKE	BOSE/ PHILIPS/ AHUJA

63	INVERTER	TOPAZ INTERNATIONAL/ LUMINOUS/ HYTES
64	CAMERA WITH ALL ACCESSORIES	HONEYWELL /PELCO/BOSCH
65	ROAD BARRIER	NICE/ MAGNETICS/ GODREJ/ GE
66	CARD READER	SENSORMATIC-USA/ MOTOROLA /HONEYWELL(XLS-3000)
67	MONITOR	ALBA/ LG/ SAMSUNG
68	VCR	BPL/ PANASONIC
69	MULTIPLEXER	SENSORMATIC OR EQUIVALENT
70	SEQUENCER	ALBA/ VANTAGE
71	PROXIMITY CARD	MOTOROLA/ HUGHES/ HONEYWELL/GE/SIEMENS
72	TELEPHONE TAG BLOCK	KRONE/ TVS R&M/SYSTIMAX/SCHNEIDER/PANDUIT
73	TELEPHONE CABLES	DELTON / SKYTONE/ CLIPSAL
74	CO-AXIAL CABLES	FINOLEX/ DELTON/SKYTONE
75	EPABX	ALKATEL/ SIEMENS/ NORTEL
76	CCTV SYSTEM	HONEYWELL/ SIEMENS /PELCO
77	IT & TELECOM SYSTEM	SCHNEIDER/ SYSTIMAX/ PANDUIT
78	FIRE ALARM SYSTEM	HONEYWELL(XLS-3000)/ SIEMENS/COOPER
79	ACCESS CONTROL SYSTEM	HONEYWELL/ SIEMENS/GE
80	BATTERIES	EXIDE/ STANDARD
81	BATTERY CHARGER	KELTRON/ NELCO/ EXIDE/ HBL NIFE
82	ALTERNATOR	STAMFORD/ CATERPILLAR/ KIRLOSKER/CROMPTON
83	ENGINE	CUMMINS/ CATERPILLAR/ KIRLOSKER
84	HT PANELS	SIEMENS/ ABB/ AREVA
85	TRANSFORMER	VOLTAMP/ ABB/ AREVA / KIRLOSKER/SUDHIR
86	UNITISED / COMPACT SUB-STATION	ABB/SIEMENS/ SCHNIEDER/SUDHIR
87	5 STAR RATED SPLIT TYPE AIR CONDITIONER & 5 STAR RATED WINDOW TYPE AIR CONDITIONER	HITACHI/CARRIER/DIAKIN

NOTE: Contractors have to take approval from Engineer in charge before placing of order of any required materials from the above mentioned approved makes . If any required materials not available in above list Engineer in charge can add the make / Brand in list at any stage with the approval of the Employer , decision will be final and binding on contractors. If any doubt about listed make / Brand Engineer in charge may amend the list at any stage , decision will be final and binding on contractors.