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PROPOSED HOTEL CLARKS - JAIPUR

TENDER DOCUMENTS FOR ELECTRICAL SYSTEM

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TECHNICAL SPECIFICATIONS

A) WIRING

1 GENERAL

Technical Specifications in this section cover the Internal Wiring Installations comprising of :

- Wiring for lights and convenience socket outlets etc. in concealed/surface conduit/raceways.
- Wiring for telephone outlets.
- Sub main wiring.
- Wiring for TV system
- Wiring for Data Networking
- Wiring for Security System
- Wiring for Fire Alarm System

2 STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

660/1100 V grade PVC insulated wires.	IS 694 : 1990
Rigid steel conduits for electrical wiring.	IS 9537 : Part I 1980
	IS 9537 : Part II 1981
PVC conduits for electrical wiring.	IS 9537 : Part III 1980
Accessories for rigid steel conduits	IS 3837 : 1990
Flexible steel conduits for electrical wiring	IS 3480 : 1990
Switch socket outlets	IS 4615 : 1990
Switches for domestic and similar purposes	IS 3854 : 1997
Boxes for the enclosure of electrical accessories	IS 5133 : Parts I &II 1969
Code of practice for personal hazard fire safety of buildings	IS 1644: 1998
Code of practice for electrical installation fire safety of buildings	IS 1646 : 1997
Code of practice for electrical wiring installations	IS 732 : 1989

3 CONDUITS

3.1 Steel Conduits

These shall be of mild steel 16 gauge up to 32mm and 14 gauge for sizes above 32mm, electric resistance welded (ERW), electric threaded type having perfectly circular tubing. Conduits shall be precession welded ERW and shall be fabricated from tested steel strips of thickness as per

ISS by high frequency induction weld process. Weld shall be smooth and of consistent of high quality to ensure crack proof bending. The conduits shall be black enamel painted inside and outside in its manufactured form. Wherever so specified, the conduit shall be galvanized. All conduits used in this work shall be ISI embossed.

3.2 PVC Conduits

Wiring shall be carried out in recessed /surface PVC conduits. The PVC conduits conform to IS 9537 Part-III and shall be ISI embossed. The conduits shall be heavy gauge (minimum 2 mm wall thickness) and the interiors of the conduits shall be free from all obstructions. All joints in conduits shall be sealed/cemented with approved solvent cement. Damage conduits/fittings shall not be used. Cut ends of conduits shall not have sharp edges.

3.3 Bends

Large right angle bends (more than 75 mm radius) or non right angle bends in conduit runs shall be made by means of conduits bending machines carefully so as not to cause any crack in the conduit. Small right angle bends in conduits runs can be made by standard conduit accessories (solid/inspection bends/elbows) no run of conduits shall have more than four right angle bends from outlet to outlet. Bends in multi runs of conduits shall be parallel to each other and neat in appearance, maintaining the same distance as between straight runs of conduits.

3.4 Conduit Accessories.

3.4.1 Standard accessories

Heavy duty black enamel painted standard conduit fittings and accessories like standard/extra-deep circular boxes, looping in boxes, junction boxes, PVC bends, PVC solid elbows, solid/inspection tees, couplers, nipples, saddles, check nuts, earth clips, ball socket joints etc. shall be of superior quality and of approved makes. Heavy duty covers screwed with approved quality screws shall be used. Superior quality screwed PVC bushes shall be used Samples of all conduits fittings and accessories shall be got approved by Project Manager before use.

3.4.2 Fabricated accessories

Wherever required, outlet/junction boxes of required sizes shall be fabricated from 1.6 mm thick MS sheets excepting ceiling fan outlet boxes which shall be fabricated from minimum 3 mm thick sheets. The outlet boxes shall be of approved quality, finish and manufacture. Suitable means of fixing connectors etc., if required, shall be provided in the boxes. The boxes shall be protected from rust by zinc phosphate primer process. Boxes shall be finished with minimum 2 coats of enamel paint of approved cooler. A screwed brass stud shall be provided in all boxes as ear thing terminal.

3.4.2.1 **Outlet Boxes For Light Fittings**.

These shall be minimum 75mm x 75mm x 50mm deep and provided with required number of threaded collars for conduit entry. For ceiling mounted florescent fittings, the boxes shall be provided 300 mm off centre for a 1200 mm fitting and 150 mm off centre for a 600 mm fitting so that the wiring is taken directly to the down rod. 3 mm thick Perspex / hylam sheet cover of matching colour shall be provided.

3.4.2.2 **Outlet Boxes For Ceiling**

Outlet boxes for ceiling fans shall be fabricated from minimum 3 mm thick MS sheet steel. The boxes shall be hexagonal in shape of minimum 100 mm depth and 60 mm sides. Each box shall

be provided with a recessed fan hook in the form of one 'U' shaped 15 mm dia rod welded to the box and securely tied to the top reinforcement of the concrete slab for a length of minimum 150 mm on either side. 3 mm thick Perspex/ hylam sheet cover of matching colour shall be provided.

3.4.3 Boxes For Modular Wiring Accessories

3.4.3.1 Switch Boxes - Modular Type

Switch boxes suitable to house modular type switches of required ratings, and fan regulators as required shall be provided. In case the number of switches in one box is not tallying with that available in standard manufacture, the box accommodating the next higher number of switches shall be provided without any extra cost. In case fan regulator/regulators is /are to be provided at a later dated, suitable provision for accommodating such regulators shall be made in the switch boxes and blank off covers shall be provided without any extra cost.

Switch boxes shall be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors, check-nuts and screwed bushes at conduit entries etc. The grid plates and M.S. boxes shall be fitted with a brass earth terminal. Boxes shall be attached to conduits by means of inserting the conduits in the outlet boxes. Extra length of conduit shall be cut-off inside the box with the help of cutting blade. Moulded front covers made from high impact resistant, flame retardant and ultra violet stabilized engineering plastics shall be fixed by means of counter sunk chromium plated brass machine screws. No timber shall be used for any supports. Switch boxes shall be located with bottom at 1200 mm above floor level unless otherwise indicated.

3.4.3.2 Modular Type Boxes For Socket/ Telephone/Call Bell Outlets

Outlet boxes shall be suitable for housing modular type switched socket outlets/ telephone outlets/ buzzers and any other outlet as required. These shall be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors. The grid plates and M.S. boxes shall be fitted with a brass earth terminal. Boxes shall be attached to conduits by means of inserting the conduits in the outlet boxes. Extra length of conduit shall be cut-off inside the box with the help of cutting blade. Moulded front covers made from high impact resistant, flame retardant and ultra violet stabilized engineering plastics shall be used to mount the outlets and shall be fixed to the outlet M.S. boxes by means of counter sunk chromium plated brass machine screws. No timber supports shall be used. Boxes shall be located at skirting level or bottom at 1200 mm from floor or inside raceways on laboratory work tables., as indicated in drawings and/or as directed.

3.5 Cross Section

The conduits shall be of ample sectional area to facilitate simultaneous drawing of wires and permit future provision also. Total cross section of wires measured overall shall not normally be more than half the area of the conduit. Maximum number of PVC insulated 660/1100 Voltage grade copper conductor cable conforming to IS - 694 - 1990 as per table give below.

Maximum no of PVC/MS insulated 660/1100 V grade aluminium/copper
Conductor cable conforming to IS : 694 – 1990

Nominal cross Sectional Area Sq mm	20 mm dia	25 mm dia	32 mm dia	40 mm dia	50 mm dia
1.0	7	13	20	-	-
2.5	6	10	14	-	-
4.0	4	8	12	14	-
6.0	3	6	8	11	-
10.0	-	5	7	9	12
16.0	-	4	6	5	6
25.0	-	2	4	2	5
35.0	-	-	2	2	5
50.0	-	-	-	2	3

4. WIRES

Wiring shall be carried out with PVC insulated 660/1100 volt grade unsheathed single core wires with electrolytic annealed stranded copper (unless otherwise stated) conductors and conforming to IS 694/1990. All wire rolls shall be ISI marked. All wires shall bear manufacturer's label and shall be brought to site in new and original packages. Manufacturer's certificate, certifying that wires brought to site are of their manufacture shall be furnished as required.

5 COAXIAL CABLES

The coaxial cables shall be of wideband type with operation up to 300 MHz capability. Aging resistance shall comply with DIM 472.52 part 2 e.i. maximum 5% increase in attenuation at 200 MHz measured by artificial aging (14 days at 80o C) cables shall meet all exceed following specifications

Center core Dia	0.8 mm
Diaelectric Dia	4.8 mm
Dielectric	PE
Outer Conductor Dia	5.4 mm
Outer Dia	7.0 mm
Bending radius	more than 30 mm
Impedance	75 ohms
D.C Resistance	50 ohms/KM
Screening factor	more than 50
Attenuation	
50 Mhz	6.5
100 Mhz	9
200 Mhz	13
300 Mhz	16

6 LAYING OF CONDUITS

- Conduits shall be laid either recessed in walls and ceilings or on surface on walls and ceilings or partly recessed and partly on surface, as required.
- Same rate shall apply for recessed and surface conduiting in this contract.

- Stranded copper conductor insulated wire of size as per schedule of quantities shall be provided in entire conduiting for loop ear thing.
- GI wire of suitable size to serve as a fish wire shall be left in all conduit runs to facilitate drawing of wires after completion of conduiting.

6.1 Recessed Conduiting

Conduits recessed in concrete members shall be laid before casting, in the upper portion of slabs or otherwise as may be instructed, so as to embedded the entire run of conduits and ceiling outlet boxes with a cover of minimum 12 mm concrete. Conduits shall be adequately tied to the reinforcement to prevent displacement during casting at intervals of maximum 1 meter. No reinforcement bars shall be cut to fix the conduits. Suitable flexible joints shall be provided at all locations where conduits cross expansion joints in the building.

Conduits recessed in brick work shall be laid in chases to be cut by electrical Contractor in brick work before plastering. The chases shall be cut by a chase cutting electric machine. The chases shall be of sufficient width to accommodate the required number of conduits and of sufficient depth to permit full thickness of plaster over conduits. The conduits shall be secured in the chase by means of heavy duty pressed steel clamps screwed to MS flat strip saddles at intervals of maximum 1 meter. The chases shall then be filled with cement and coarse sand mortar (1:3) and properly cured by watering.

Entire recessed conduit work in concrete members and in brick work shall be carried out in close coordination with progress of civil works. Conduits in concrete members shall be laid before casting and conduits in brick work shall be laid before plastering. Should it become necessary to embedded conduits in already cast concrete members, suitable chase shall be cut in concrete for the purpose. For minimizing this cutting, conduits of lesser diameter than 25 mm and outlet boxes of lesser depth than 50 mm could be used by the Contractor for such extensions only after obtaining specific approval from Project Manager . For embedding conduits in finished and plastered brick work, the chase would have to be made in the finished brick work. After fixing conduit in chases, chases shall be made good in most workmanlike manner to match with the original finish.

Cutting chases in finished concrete or finished plastered brick work for recessing conduits and outlet boxes etc shall be done by the Contractors without any extra cost.

6.2 Surface Conduiting

Wherever so desired, conduit shall be laid in surface over finished concrete and/or plastered brickwork. Suitable spacer saddles of approved make and finish shall be fixed to the finished structural surface along the conduit route at intervals not exceeding 600 mm. Holes in concrete or brick work for fixing the saddles shall be made neatly by electric drills using masonry drill bits. Conduits shall be fixed on the saddles by means of good quality heavy duty MS clamps screwed to the saddles by counter sunk screws. Neat appearance and good workmanship of surface conduiting work is of particular importance. The entire conduit work shall be in absolute line and plumb.

6.3 Fixing of conduit fittings and accessories

For concealed conduiting work, the fittings and accessories shall be completely embedded in walls/ceilings leaving top surface flush with finished wall/ceiling surface in a workman like manner.

Loop earthing wire shall be connected to a screwed earth stead inside outlet boxes to make an effective contact with the metal body.

6.4 Painting and Colour coding of conduits

Before laying, conduits shall be painted specially at such places where paint has been damaged due to vice or wrench grip or any other reason.

If so specified, surface conduits shall be provided with 20 mm wide and 100 mm long colour coding strips as below

Use	Code colour
Low voltage	Grey
Telephone	Black
Earthing system	Green
Control system lighting	Purple

6.5 Protection of Conduits

To safeguard against filling up with mortar/plaster etc. all the outlet and switch boxes shall be provided with temporary covers and plugs which shall be replaced by sheet/plate covers as required. All screwed and socket joints shall be made fully water tight with white lead paste.

6.6 Cleaning of Conduit Runs

The entire conduit system including outlets and boxes shall be thoroughly cleaned after completion of erection and before drawing in of cables.

6.7 Protection Against Dampness

All outlets in conduit system shall be properly drain and ventilated to minimize chances of condensation/sweating.

6.8 Expansion Joints

When crossing through expansion joints in buildings, the conduit sections across the joint shall be through approved quality heavy duty metal flexible conduits of the same size as the rigid conduit.

6.9 Loop Earthing

Loop earthing shall be provided by means of insulated stranded copper conductor wires of sizes as per Schedule of Quantity laid along with wiring inside conduits for all wiring outlets and sub-mains. Earthing terminals shall be provided inside all switch boxes, outlet boxes and draw boxes etc.

7 LAYING AND DRAWING OF WIRES

7.1 Bunching of Wires

Wires carrying current shall be so bunched in conduits that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit.

7.2 Drawing of Wires

The drawing of wires shall be done with due regard to the following precautions:-

- No wire shall be drawn into any conduit, until all work of any nature, that may cause injury to wire is completed. Burrs in cut conduits shall be smoothen before erection of conduits. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Approved type bushes shall be provided at conduit terminations.

- Before the wires are drawn into the conduits, conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction by forcing compressed air through the conduits if necessary..

- While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which cause breakage of conductors.

- There shall be no sharp bends.

- The Contractor shall, after wiring is completed, provide a blank metal/sun mica plate on all switch / outlet / junction boxes for security and to ensure that wires are not stolen till switches / outlets etc.. are fixed at no extra cost the contractor shall be responsible to ensure that wires and loop earthing conductors are not broken and stolen. In the event of the wire been partly / fully stolen , the contractor shall replace the entire wiring along with loop earthing at no extra cost. No joint of any nature whatsoever shall be permitted in wiring and loop earthing .

7.3 Termination /Jointing of Wires

- Sub-circuit wiring shall be carried out in looping system. Joints shall be made only at distribution board terminals, switches/buzzers and at ceiling roses/connectors/lamp holders terminals for lights/fans/socket outlets. No joints shall be made inside conduits or junction/draw/inspection boxes.

- Switches controlling lights, fans or socket outlets shall be connected in the phase wire of the final sub circuit only. Switches shall never be connected in the neutral wire.

- Wiring conductors shall be continuous from outlet to outlet. Joints where unavoidable, due to any special reason shall be made by approved connectors. Specific prior permission from Project Manager in writing shall be obtained before making such joint.

- Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or wringing.

- Strands of wires shall not be cut for connecting terminals. All strands of wires shall be twisted round at the end before connection..

- Conductors having nominal cross sectional area exceeding 1.5 sq. mm shall always be provided with crimping sockets. Tinning of the strands shall be done wherever crimping sockets are not available as per instructions of the Project Manager

- All wiring shall be labelled with appropriate plastic ferrules for identification.

- At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used.

- Brass nuts and bolts shall be used for all connections.

- The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less.

- Switches controlling lights, fans, socket outlets etc. shall be connected to the phase wire of circuits only.

- Only certified valid license holder wiremen shall be employed to do wiring / jointing work.

7.4 Load Balancing

The Contractor shall planed the load balancing of circuits in 3 phase insulation and get the same approved by the Project Manager before commencement of the work.

7.5 Colour Code of Conductors

Colour code shall be maintained for the entire wiring installation - red, yellow, blue for three phases, black for neutral and green for earth.

8. SWITCHES AND FIXTURES

8.1 SWITCHES

All 6 and 16 amps switches shall be of the modular enclosed type flush mounted 220 Volt AC of the best quality and standard. The switch moving and fixed contacts shall be of silver nickel and silver graphite alloy and contact tips coated with silver. The housing of switches shall be made from high impact resistant, flame retarding and ultra violet stabilized engineering plastic material.

The switch controlling the light point shall be connected on to the phase wire of the circuit.

8.2 FLUSH PLATES

Switches, receptacles and telephone system outlets in wall shall be provided with molded cover plates of shape, size and colour approved by the Project Manager made from high impact resistant, flame retarding and ultra violet stabilized engineering plastic material, and secured to the box with counter sunk round head chromium plated brass screws. Where two or more switches are installed together, they shall be provided with one common switch cover plate as described above with notches to accommodate all switches either in one, two or three rows.

One and two gang switch cover plate, telephone outlet cover plate, 6 and 16 amps switched/ un switched plates, shall have the same shape and size. Three and four gang switch cover plates shall have the same shape and size. Six and eight gang switch cover plates shall have the same shape and size. Nine and twelve switch cover plates shall have the same shape and size. Wherever five switches, seven switches, ten switches and eleven switches are to be fixed the next higher size of gang switch cover plate to be used and extra openings shall be provided with blank-off.

8.3 EXTERNALLY OPERATED SWITCHES

Externally operated switches, shall be of general purpose type, 250 volts of the proper size and rating and shall be provided in weather proof enclosures, complete with weather proof gasket covers. The MCB's for all externally operated switches shall be separate and of proper rating.

8.4 WALL SOCKET OUTLETS

All 6/16 amps wall socket outlets unless otherwise mentioned on the drawings shall be switched, five/six round pin and fitted with automatic linear safety shutters to ensure safety from prying fingers. Un switched 6/16 amp wall socket outlets where called for in the drawings shall be of five/six round pin type. The socket outlets shall be made from high impact resistant, flame retarding and ultra violet stabilized engineering plastic material.

The switch and sockets shall be located in the same plate. The plates for 6 amp switched/un switched plugs and telephone outlets shall be of the same size and shape.

All the switched and un switched outlets shall be of the best standard.

The switch controlling the socket outlet shall be on the phase wire of the circuit.

An earth wire shall be provided along the cables feeding socket outlets for electrical appliances. The earth wire shall be connected to the earthing terminal screw inside the box. The earth terminal of the socket shall be connected to the earth terminal provided inside the box.

8.5 LIGHTING FIXTURES

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

Wires brought out from junction boxes shall be encased in GI flexible pipes for connecting to fixtures concealed in suspended ceiling. The flexible pipes shall be provided with a checknut at the fixture end.

Pendant fixtures specified with overall lengths are subject to change and shall be checked with conditions of the job and installed as directed.

All suspended fixtures shall be mounted rigid and fixed in position in accordance with drawings, instructions and to the approval of the Project Manager.

Fixtures shall be suspended true to alignment, plumb, level and capable of resisting all lateral and vertical forces and shall be fixed as required.

All suspended light fixtures etc. shall be provided with concealed suspension arrangement in the concrete slab/roof members. It is the duty of the Contractor to make these provisions at the appropriate stage of construction.

All switch and outlet boxes shall be bonded to earth with insulated stranded copper wire as specified.

Wires shall be connected to all fixtures through connector blocks.

Flexible pipes, wherever used, shall be of make and quality approved by the Project Manager.

9. MEASUREMENT AND PAYMENT OF WIRING

Wiring for lights, fans, convenience socket outlets and telephone outlets etc. shall be measured and paid for on POINT BASIS as itemized schedule of quantities and as elaborated as below unless otherwise stated.

9.1 Primary and Secondary light point wiring

In respect of group control of lights (more than one light controlled by one switch or MCB), wiring up to the first light in the group shall be measured and paid for as a primary light point. Wiring for other lights looped in one group for switch controlled as also MCB controlled lights shall be measured and paid for as secondary light points. Primary light points for switch controlled lights shall include the cost of control switch whereas primary light points controlled by MCBs shall not include the switch cost. The cost of MCB controlling such lights shall not be included in the primary light point rate since the MCB shall be paid for in the item of DB.

The point wiring basis shall assume average wiring length and average conduiting length per point based on parameters stipulated in Para 9.2 below. The average wiring length and average conducting length forming the basis of point wiring payment, shall take the electrical layouts of the entire project into consideration. Tenderers are advised to seek clarifications, if they so desire, on this aspect before submitting their tenders. No claim for extra payment on account of electrical layouts in part or whole of the project requiring larger average wiring and conduiting length per point, whether specifically shown in tender drawings or not, shall be entertained after the award of contract.

9.2 Parameters: Wiring shall be carried out as per following parameters in recessed/ surface conduit system.

- Only looping system of wiring shall be adopted throughout. No joints excepting at wiring terminals shall be permitted.
- All accessories shall be flush type unless otherwise stated.
- For estimation of load, following loads per point shall be assumed.

Light points	100 Watts.
6 amps socket outlet points	100 Watts.
Fan points	60 Watts.
Exhaust fan points	300 Watts or as specified.
16 amp socket outlet points	1000 Watts.

- Lights, fans and 6 amp socket outlets may be wired on a common final such circuit. Such circuit shall not normally have more than a total of ten lights, fans or socket outlets or a load of 800 watts whichever is lesser.
- Power circuits shall normally have maximum one 16 amps socket outlet unless otherwise stated. Separate circuit shall be run for each geyser, kitchen equipment, window air conditioners and similar appliances.

- Wiring rates shall include painting of conduits and other accessories as required.
- Wiring rates shall include cleaning of dust, splashes of colour wash or paint from all fixtures, fans, fittings etc. at the time of taking over of the installation.
- Wiring rates shall include blanking of outlet boxes to prevent damage/pilferage of wires

9.3 Definitions

9.3.1 Wiring for Lights

Primary Light Points : Wiring for primary light points, as defined in para 9.1 above, shall commence at the Distribution Board terminals and shall terminate at the ceiling rose/connector in ceiling box/lamp holder via the control switch (for switch controlled lights). Rates for primary light point wiring shall be deemed to be inclusive of the cost of entire material and labour require for completion of primary light point thus defined including : .

- Recessed / surface conduting system with all accessories, junction/draw/inspection boxes, bushes, check nuts etc. complete as required,

- Wiring with stranded copper conductor PVC insulated 660/1000 volt grade wires including terminations etc. complete as required.
- Control switch with switch box and cover plate of specified type including fixing screws, earth terminal etc. complete as required. Cost of this switch is applicable only for switch controlled points. This cost shall not be applicable for DB controlled points.
- Loop earthing with insulated copper wires.

Secondary Light points :
Secondary light points, as defined in para 9.1 above, shall cover the cost of interconnection wiring between group controlled light fittings and shall be deemed to be inclusive of the cost of entire materials and labour required for completion of the secondary light point thus defined including

- Recessed / surface conduting system with all accessories, junction/draw/inspection boxes, bushes, check nuts etc. complete as required,
- Wiring with stranded copper conductor PVC insulated 660/1000 volt grade wires including terminations etc. complete as required.
- Loop earthing with insulated copper wires.

9.3.2 Wiring for Ceiling Fans

Wiring for ceiling fan points shall be same as for primary light points and shall, in addition, include ceiling outlet box with recessed fan hooks.

9.3.3 Wiring for Exhaust Fans

Wiring for exhaust fan points shall be same as for primary light points and shall in addition include the cost of providing a 3/5 pin 6 amp socket outlet near the fan along with plug top and a 6 amp control switch at convenient location near the room entry.

9.3.4 Wiring for Call Bell Points

Wiring for call bell points shall be the same as for primary light points and shall in addition include the cost of a call bell/buzzer of approved type and make in the required location and a call bell in lieu of the control switch at a convenient location as required.

9.3.5 Wiring for Telephone Outlets

Wiring for telephone outlets points shall include the entire wiring and conduiting from the telephone tag block to the telephone outlet including the telephone outlet complete as required and as itemized in the Schedule of Quantities

9.3.6 Wiring for TV Outlets

Wiring for TV outlet points shall include the entire wiring and conduiting from the central point to the TV outlet including the TV outlet complete as required and as itemized in the Schedule of Quantities

9.3.7 Wiring for Convenience Socket Outlets

3/5 pin 6 amps and 3/6 pin 16 amps single phase switched convenience socket outlets shall be provided in the building as indicated in the layout drawings. In addition, combined 3 pin 6 / 16 amps socket outlets at modular intervals in special PVC raceway over the work tables in laboratories shall be provided. Wherever required, 20/32/50 amps single phase and 32/50 amps 3 phase outlets shall also be provided.

Wiring for 3/5 pin 6 amps convenience socket outlets

Point wiring for 3/5 pin 6 amps socket outlets (in locations other than over the laboratory work tables) on point wiring basis shall be the same as primary light point defined in para 8.3.1 and shall in addition include 3/5 pin 6 amp socket outlet with 6 amp control switch in MS box with cover. including loop earthing of the third pin complete as required as itemized in scheduled of quantities.

Wiring for 3/6 pin 16 amps convenience socket outlets

Point wiring for 3/6 pin 16 amps socket outlets (in locations other than over the laboratory work tables) on point wiring basis shall be the same as primary light point defined in para 8.3.1 and shall in addition include 3/6 pin 16 amp socket outlet with 16 amp control switch in MS box with cover including loop earthing of the third pin complete as required as itemized in scheduled of quantities.

Wiring for special socket outlets

In addition to the above, special convenience outlets of 20/32/50 amps single phase and 32/50 amps three phase, required in few locations as indicated in the layout drawings, shall be paid for on linear basis as itemized in schedule of quantities. Outlets only shall be paid separately in

numbers as per actual. Wiring along with loop earthing shall be paid separately on running meter basis and conduiting /PVC raceway shall be paid separately on running meter basis.

9.3.8 Sub mains wiring

Sub mains wiring shall be measured from outer end of the boxes. Extra Loop length shall be left at each end as required.

10. ROUTINE AND COMPLETION TESTS

10.1 Installation Completion Tests

At the completion of the work, the entire installation shall be subject to the following tests:

1. Wiring continuity test
2. Insulation resistance test
3. Earth continuity test
4. Earth resistivity test

Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the contractor at his own cost.

10.2 Wiring Continuity Test

All wiring systems shall be tested for continuity of circuits, short circuits, and earthing after wiring is completed and before installation is energized.

10.3 Insulation Resistance Test

The insulation resistance shall be measured between earth and the whole system conductors, or any section thereof with all protection in place and all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 1100 volts for medium voltage circuits. Where the supply is derived from AC three phase system, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 mega ohms divided by the number of points provided on the circuit the whole installation shall not have an insulation resistance lower than one mega ohm.

The insulation resistance shall also be measured between all conductors connected to one phase conductor of the supply and shall be carried out after removing all metallic connections between he two poles of the installation and in those circumstances the insulation shall not be less than that specified above.

The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant Standard specification or where there is no such specification, shall not be less than half a mega ohm or when PVC

insulated cables are used for wiring 12.5 mega ohms divided by the number of outlets. Where a whole installation is being tested a lower value than that given by the above formula subject to a minimum of 1 Mega ohms is acceptable.

10.4 Testing Of Earth Continuity Path

The earth continuity conductor including metal conduits and metallic envelopes of cable in all cases shall be tested for electric continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance of earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

10.5 Testing Of Polarity Of Non-Linked Single Pole Switches

In a two wire installation a test shall be made to verify that all non-linked single pole switches have been connected to the same conductor throughout, and such conductor shall be labelled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three of four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Project Manager as well as the local authorities.

10.6 Earth Resistivity Test

Earth resistivity test shall be carried out in accordance with IS Code of Practice for earthing IS 3043.

10.7 Performance

Should the above tests not comply with the limits and requirements as above the contractor shall rectify the faults until the required results are obtained. The contractor shall be responsible for providing the necessary instruments and subsidiary earths for carrying out the tests. The above tests are to be carried out by the contractor without any extra charge.

10.8 Tests And Test Reports

The Contractor shall furnish test reports and preliminary drawings for the equipment to the Project Manager for approval before commencing supply of the equipment. The Contractor should intimate with the tender the equipment intended to be supplied with its technical particulars. Any test certificates etc., required by the local Inspectors or any other Authorities would be supplied by the Contractor without any extra charge. All test reports shall be approved by the Project Manager prior to energizing of installation.

B) MEDIUM VOLTAGE DISTRIBUTION BOARDS

1. GENERAL

This section covers specification of DBs.

2. STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

Miniature Air Circuit Breakers for AC circuits	IS 8828 : 1978
Degrees of Protection provided by enclosures for low voltage switchgear	IS 2147 : 1962
Code of Practice for installation and maintenance of switchgear not exceeding 1000 volts	IS 10118 : 1982
General requirements for switchgear and control gear for voltages not exceeding 1000 volts	IS 4237 : 1982

3. MINIATURE CIRCUIT BREAKERS

- The MCB's shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system.
- The MCB's shall have a rupturing capacity of 10 KA at 0.5 p.f.
- The MCB's shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection. The MCB time current characteristic shall coordinate with PVC cable characteristic.
- Type test certificates from independent authorities shall be submitted with the tender.

4. FINAL DISTRIBUTION BOARDS

- Final distribution boards shall be flush mounting, totally enclosed, dust and vermin proof and shall comprise of miniature circuit breakers, earth leakage circuit breakers, neutral link etc as detailed in the schedule of quantities.

- The distribution equipment forming a part of the Distribution Boards shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and as per detailed specifications included in this tender document.

- The board shall be fabricated from 16 gauge CRCA sheet steel and shall have a hinged lockable spring loaded cover. All cut-outs and covers shall be provided with synthetic rubber gaskets. The entire construction shall give a IP 42 degree of protection.

- The bus-bar shall be of electrical grade copper having a maximum current density of 1.6 ampere per square mm and PVC insulated throughout the length. The minimum spacing between phases shall be 25 mm and between phase and earth 19 mm

- Separate neutral link for each phase shall be provided.

- All the internal connections shall be with either solid copper PVC insulated or copper conductor PVC insulated wires of adequate rating.

- All the internal connections shall be concealed by providing a hinged protective panel to avoid accidental contact with live points.

- All outgoing equipment shall be connected direct to the bus bar on the live side. The equipment shall be mounted on a frame work for easy removal and maintenance.

- The sheet steel work shall undergo a rigorous rust proofing process, two coats of filler oxide primer and final powder coated paint finish.

- All the circuits shall have an independent neutral insulated wire, one per circuit, and shall be numbered and marked as required by the Project Manager.

- A sample of the completed board is to be got approved by the Project Manager before commencement of supply and erection.

- Before commissioning, the distribution boards shall be meager tested for insulation and earth continuity.

5 SHEET STEEL TREATMENT AND PAINTING

- Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, de-scaling in dilute sulphuric acid and a recognized phosphating process. The steel work shall then receive two costs of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.

- All sheet steel shall after metal treatment be given powder coated finish painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns.

6. NAME PLATES AND LABELS

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

C) EARTHING

1.0 GENERAL

This section covers the general arrangement of the earthing, i.e. all non-current carrying metal parts of the electrical installation shall be earthed as per IS 3043(1987) and general specifications for electrical works (part-1, internal) of CPWD specifications. All metal conduits, trunkings, cable sheaths, switchgear, distribution boards, meters, light fixtures, fans and all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to earth electrodes. Earthing shall also be in conformity with the provisions of Rule 32, 61, 62, 67 and 88 of IER 1956. The earth electrode shall not be situated less than 1.5 mtr.

2.0 EARTHING SYSTEMS

It shall comprise of earth electrodes, earth strips, earth continuity conductor and all earthing conductors shall be of high conductivity copper, GI or aluminium and shall be protected against mechanical damage and corrosion. The size of earth conductors shall not be less than half that of the largest current carrying conductor. The connection of earth continuity conductors of earth bus and earth electrodes shall be strong and sound and shall be rigidly fixed to the walls, cable trenches, cable trays or conduits and cable by using suitable clamps made of non ferrous metals.

3.0 EARTHING ELECTRODES

Earthing electrodes shall be designed as per the requirement of IS 3043 (1987). The number and size of earth electrodes shall be calculated so that under fault conditions no electrode is loaded above its maximum permissible current density. The resistance of earth electrode shall be as low as possible, the maximum allowable value being one ohm.

Earthing electrodes of either plate type or pipe type may be adopted. The choice of plate or pipe electrode shall be decided according to the anticipated fault level of the network and local soil conditions. Generally, plate electrodes shall be used for substations and large medium voltage network and pipe electrodes for small medium voltage network and installations.

3.1 Location of Earth Electrodes

Normally on earth electrode shall not be situated less than 1.5 m from any building. Care shall be taken that the excavation for earth electrode may not effect the column footings or foundation of the buildings. In such cases electrodes may be further away from the building.

The location of the earth electrode will be such where the soil has reasonable chance of remaining moist. As far as possible, entrances, pavements and road ways, are to be definitely avoided for locating earth electrode.

3.2 Water Arrangement

Method of watering arrangement shall comply with CPWD General Specifications.

3.3 Plate Electrode

Plate electrodes shall be made of GI plate of 6 mm thick and 60x60 cm. size. The plate shall be buried vertically in ground at depth of not less than 3.5 metres to the top of the plate, the plate being encased in charcoal to a thickness of 15 cm. all round. It is preferable to bury the electrode to a depth where sub-soil water is present. Earth leads to the electrode shall be laid in a GI pipe and connected to the plate electrode with GI bolts, nuts and washers. A GI pipe of not less than 19 mm dia shall be placed vertically over the plate and terminated in a funnel at 5 cm. above ground. The funnel shall be provided with a wire mesh. The funnel shall be enclosed in masonry chamber of 100 x 50 cm. dimensions. The chamber shall be provided with CI frame cover of 100 x 50 cm size. The earth station shall also be provided with a suitable permanent identification label/tag.

Note : If copper plate is used it shall be of 3mm thickness.

3.4 Pipe electrode shall comprise of a 2.5 Mtr. long 40 mm dia GI pipe buried vertically in a pit of 35 x 35 cm size and filled with alternate layers of charcoal, salt and river sand and connected at the top to a GI pipe of 19 mm, 1 Mtr. long with a funnel at the other end, 5 cm above the ground. The earth lead shall be properly fixed to the pipe electrode with brass bolts, nuts and washers. The funnel and earth lead connections shall be enclosed in a masonry chamber of 30 x 30 x 30 cm. dimensions. The chamber shall be provided with a CI frame and CI cover. Proper permanent identification tag/label shall be provided for each electrode.

4.0 INSTALLATION

4.1 All joints shall be reverted and sweated. Joints in the earth bar shall be bolted and the joints faces tinned. Where the diameter of the bolt for connecting earth bar to apparatus exceeds one quarter of the width of the earth bar, the connection to the bolt shall be made with a wider piece of flange of copper jointed to earth bar. These shall be tinned at the point of connection and special care taken to ensure a permanent low resistance contact to iron or steel. All steel bolts, nuts, washers, etc shall be cadmium plated. Main earth bars shall be spaced sufficiently away from the surface to which they are fixed, such as walls or the side of trenches to allow for easy connections. Copper earth bars shall not be fixed by ferrous fittings. The earthing shall be suitably protected from mechanical injury by galvanized iron within ground shall be buried at least 60 cm deep. The earthing lead shall be securely bolted and soldered to the plate or pipe as the case may be. In the case of the plate, the lead shall be connected by means of cable socket with two bolts and nuts. All washers shall be of the same materials as the plate or pipe. All iron bolts, nuts and washers shall be galvanized.

4.2 Method of Installation of watering arrangement

In the case of plate earth electrode a watering pipe of 20 mm dia of medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on the top for watering the pit. In case of pipe earth electrode a 40 mm x 20 mm reducer shall be used for accessing the funnel. The watering funnel attachment shall be housed in masonry enclosure of

not less than 30 cm x 30 cm x 30 cm. A cast iron cover having locking arrangement shall be suitably embedded in the masonry enclosure.

5.0 PRECAUTIONS

5.1 Earthing system shall be mechanically robust and the joints shall be capable of retaining low resistance even after passages of fault currents.

5.2 Joints shall be soldered, tinned and double riveted. All the joints shall be mechanically and electrically continuous and effective. Joints shall be provided against corrosion.

5.3 The earthing lead from electrode onwards shall be suitably protected from mechanical injury by a 15 mm dia GI pipe in case of wire and by 40 mm dia medium class GI pipe in case of strips. Portion of this protection pipe within the ground shall be buried at least 30 cm deep (to be increased to 60 cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floor to adequate depth.

6.0 TESTING

6.1 On the completion of the entire installation, the following tests shall be conducted and no earth electrode shall have ohmic resistance of more than 2 ohm and in rocky soil not more than 3 ohms.

a) Earth resistance of electrodes

b) Impedance of earth continuity conductors as per E-3 of IEE regulations.

c) Effectiveness of earthing as per E-4 & E-5 of IEE regulations.

6.2 All meters, instruments and labour required for the tests shall be provided by the contractor. The test results shall be submitted in triplicate to the Architects for approval.

D) LIGHTNING PROTECTION SYSTEM

1 STANDARDS

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of the Contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall apply. Wherever appropriate Indian Standards are not available relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

Code of Practice for the Protection of buildings and Allied Structures against Lightning	IS 2309 : 1989
Code of Practice for Earthing	IS 3043 : 1987

2 GENERAL

The Lightning Protective System shall comprise of Air Terminations, Down Conductors, Earth Terminations etc as required. The System shall preferably use the same conducting material throughout and will comply to the detailed specifications detailed hereinafter.

The entire lightning system should be mechanically strong to withstand the mechanical forces produced in case of a lightning stroke.

3 MATERIALS

The materials of which the protective system is composed shall be resistant to corrosion or be adequately protected against corrosion. The material shall be as specified in the Schedule of Quantities and shall comply to the following requirements:

a) Copper - When solid or stranded copper wire is used it shall be of the grade ordinarily required for commercial electrical work generally designated as being of 98% conductivity when annealed, conforming to Indian Standard Specifications.

b) Galvanised Steel - Galvanised steel used shall be thoroughly protected against corrosion by hot dipped Zinc coating. The material coating shall withstand the test specified in IS 2309:1968.

c) The strips to be used shall be in maximum lengths available as manufactured normally avoiding unnecessary joints.

4 AIR TERMINATIONS

4.1 Vertical Air Terminations

Vertical air terminations shall comprise of finials made of 25 mm dia GI tube with single or multiple prongs at the top. Vertical terminations where provided shall project 30 cms above the project salient point or net work on which it is fixed.

4.2 Horizontal Air Terminations

Horizontal air terminations should be so interconnected that no part of the roof is more than 9 m away from the nearest horizontal conductor. For a flat roof horizontal air termination along the outer perimeter of the roof is to be used. For a roof of larger area a net work of parallel horizontal conductors shall be installed. Horizontal air terminations should be coursed along contours such as ridges, parapets and edges of the flat roofs and where necessary over flat surfaces in such a way as to join each air termination to the rest and should themselves form a closed network.

All metallic finials, chimneys, duct, vent pipes, railings, gutters, and the like on or above the main surface of the roof of the structure should be bonded to and form part of the air termination network.

5 DOWN CONDUCTORS

The Down Conductors shall be of material as specified in the Schedule of Quantities. These shall be distributed around the outside walls of the structure and shall preferable be run along the corners and other projections. Lift shafts shall not be used for fixing the Down Conductors.

The routing of the Down Conductors shall be such that it is accessible for inspection, testing and maintenance.

6 TESTING JOINTS AND BENDS

The lightning protective system should have as few joints in it as possible.

Wherever joints in the down conductor above ground level are necessary they shall be mechanically and electrically effective.

In the down conductor below ground level there shall be no joints.

The joints may be clamped, screwed, bolted, riveted, sweated braced or welded. Bolted joints should be used on test points or on bonds to existing metal.

Each down conductor should be provided with a testing joint in a position convenient for testing but inaccessible for interference.

7 FASTENERS

Conductors shall be securely attached to the building by fasteners which shall be substantial in construction, not subject to breakage.

These shall be of galvanized steel or other suitable materials with suitable precautions to avoid corrosion.

The method and nature of the fixing should be simple, solid and permanent. The lightning conductors shall be secured at not more than 1.20 m apart for horizontal run and 1.00 m for vertical run.

8 EARTH TERMINATION

Each down conductor shall have an independent earth termination and all earth terminations should be interconnected.

9 EARTH ELECTRODES

Earth electrodes shall be constructed and installed as laid down in the IS 3043.

9.1 Plate Earth Electrode

The plate electrodes shall be of Copper or G.I. as called for in the Bill of Quantities. The minimum dimensions of the electrode shall be G.I. 600 mm x 600 mm x 6 m thick and for Copper 600 mm x 600 mm x 3 mm.

The electrode shall be buried in ground with its face vertical and top not less than 3 m below ground level.

9.2 Earth Electrode Pit

In the case of plate earth electrode, a watering pipe of 20 mm dia of medium class G.I. Pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided at the top of this pipe for watering the earth. The watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300 mm. A cast iron/M.S. frame with cover having locking arrangement shall be suitably embedded in the masonry enclosure.

9.3 Location Of Earth Electrode

The following guidelines shall be followed for locating the earth electrodes

- An earth electrode shall not be situated less than 2 meters from any building.
- The excavations for electrode shall not affect the column footings or foundations of the buildings. In such cases electrode may be further away from the building.
- The location of the earth electrode shall be such where the soil has reasonable chance of remaining moist, as far as possible.
- Entrances, pavements and road ways shall not be used for locating the earth electrode.

10 EARTH RESISTANCE

The whole of the lightning protective system should have a combined resistance to earth not exceeding 10 ohms before any bonding has been effected to metal or on a surface or to surface below ground.

E) MEDIUM VOLTAGE PANELS:

1.0 GENERAL

Medium voltage power control centers (generally termed as switchboard panels) shall be in sheet steel clad cubicle pattern, free floor standing wall mounting type, totally enclosed, compartmentalized design having multi tier arrangement of the incomers and feeders as per details given in the schedule of quantities. The panels shall be of extensible type with provision of bus bar extensions. All panels shall conform to the requirements of the latest addition of IS and shall be suitable for 415 V, 3 phase AC supply or 230 V single phase AC supply as required.

2.0 CONSTRUCTION

All switch board panels or power control centres of free standing type shall have a bus bar chamber at the top and the cable compartment at the bottom or as approved by the Architects/Consultants depending upon the specific requirements of the job. The space between the bus chamber and cable compartment shall be suitably compartmentalized to accommodate either air circuit breakers or switch fuse feeders of various ratings. The cable termination's shall be carried out on the rear side of the panels for which adequate space and clamping arrangements shall be provided. Where panels have to be installed with very little access space at the rear, the cable termination's shall be carried out in suitable cable alleys provided on the front of the panel. All the live parts shall be properly shrouded with Bakelite barriers. All the equipment shall be accessible from the front. However, protection relays, KWH meters, etc. may be mounted on the rear side/front side if required. Arrangements and marking of bus bars, main connections and wiring shall be in accordance with IS: 5578 -1985 and 11353-1985.

The structure of the panel shall be robust and provided with adequate bracing's to withstand the operation of the equipment and stresses due to system short circuit. The panels shall be fabricated out of best quality heavy gauge sheet steel. The panel shall be machine pressed with punched openings for meters, indicating lamps etc.

3.0 DIMENSIONS

All power control centres shall have dimensions of not more than that given on the layout drawings. Panels arranged side by side shall have the same height and depth. The height of the panel should be limited to 2200 mm. All the operating levers, handles etc. of the highest unit shall not be at a height more than 1700mm from F.F.L. For all incoming cables a removable gland plate will be provided in the panel and a minimum distance of 300 mm will be provided between the gland plate and the nearest terminal for proper dressing and termination of the cable. All the components of a module will be mounted on a component plate using the machine screws and taped holes (excepting the components mounted on the door). These component plates should be fixed with bolts for easy replacement. Standardization will be adopted while making these plates so that the component plates of the same size modules can be changed from one module to another. In case of panel of lengths more than 4 meters the fabrication of any single section will be limited to a maximum length of 4 mtr. for the purpose of shipping and shifting at the site. These sections will be assembled at the location of installation with the help of nuts and bolts. While making these sections consideration will be given to the place of sectionalisation and select the location where the minimum electrical connections are transferred from one section to another. All the hardwires used in the assembly will be electroplated for protection and neat appearance.

4.0 BUS BARS

The bus bars shall be suitable for 4 wire, 415 volts, 50 Hz, system. The main bus bar shall be made of high conductivity electricity conductor grade electrolytic AL 91E Aluminium and shall be liberally sized. In case of copper bus bar it shall be electrically conductor grade electrolytic copper and at the time of joining of two copper buses tinning will be done on the copper strips ends to a length equal to the lap length of the joint plus one each. The bus bars shall have uniform cross section throughout. The bus bars shall be capable of carrying the rated current at 415 volts continuously. The bus bar will run in a separate bus bar chamber using bus insulators made of non-deteriorating, vermin proof, non hygroscopic materials such as epoxy fibre,

reinforced polyester or moulding compound. The interval between the two insulators will be designed after considering:

a) Strength and safe load rating of the insulator,
b) The vibrating force generated during a fault,
c) A Factor of safety of 1.8
d) A set of insulators at both ends of the bus.

The size of the bus bar calculations must be approved by the consultants. The bus bars shall be designed to withstand a temperature rise of 45^{o} above the ambient. To limit the temperature rise in the bus bar chamber a set of louvers can be provided at strategically places considering the air circulation. The louvers provided will have a brass wire mesh covering from inside with more than 100 openings per sq. inch. The overall temperature of bus bar shall not exceed 85°C in any case. A current density of 1.0 Amps/Sq. mm shall not be exceeded for aluminium bus bars.

All the bus bars shall be insulated with PVC heat shrinking sleeves suitably throughout (except at joints) the length. The electro galvanized high tensile steel nuts, bolts, plain or spring washers of suitable size will be used in connecting the various section of the bus bar. A minimum of 1.6 times the width of bus bar will be the lapping length of each joint.

5.0 EARTHING

The panels shall be provided with an aluminium or copper earth bus of suitable size running through out the length of the switchboard. Suitable earthling eyes/bolts shall be provided on the main earthing bus to connect the same to the earth grid at the site. Sufficient number of star washers shall be provided at the joints to achieve earth continuity between the panels and the sheet metal parts.

6.0 INTERLOCKING

The panels shall be provided with the following interlocking arrangement.

a) The door of the switch-fuse compartments is so interlocked with the switch drive or handle that the door can be opened only if the switch is in `OFF' position. De-interlocking arrangement shall also be provided for occasional inspection.

b) It shall not be possible for the breaker to be withdrawn when in `ON' position.

c) It shall not be possible for the breakers to be switched on unless it is either in fully inserted positions or for testing purposes in fully isolated position.

d) The breaker shall be capable of being raked in to `testing' `isolated' and `maintenance' positions and kept locked in any of these position.

e) A safety latch to ensure that the movement of the breaker as it is withdrawn, is checked before it is completely out of the cubicle shall be provided.

7.0 PROTECTION & INSTRUMENTATION

Protection and instrumentation shall be as per standard specifications.

8.0 CONTROL WIRING

The control wiring of all the panels will be done with PVC single core flexible copper wires of cross section 1.5 sq. mm and 2.5 sq. mm. All the wiring involving current transformers or circuits with currents of more than 5 Amps will be wired with 2.5 sq. mm cross section wire and the others with 1.5 sq. mm. Similarly all the interconnecting between the incoming bus and the outgoing of 100 Amps and above rating shall be done by insulated copper strips of suitable sizes and equipment below 10 Amps rating shall be wired with insulated copper conductors. All of the control wiring will be done by properly dressing all the wires in a laminar manner either in a PVC duct of liberal size or bunched together by PVC strapping tapes at a distance not exceeding 150 mm. Each wire will terminate with a copper ferule crimped to the wire. The PVC ferules will be used to identify each wire of the circuit and the same number will be marked on the drawing for the corresponding wire. Only one outgoing wire will be connected to one connector. When the control wiring is crossing from fixed parts to moving parts such as door etc. the wire will be run in PVC sleeve of suitable size and the same will be mechanically clamped at both the ends i.e. one end of the fixed part and the other on the moving part. Under no circumstances the wiring should be under any kind of stress for which sufficient length of control wiring in the PVC sleeve should be provided. All the potential circuits shall be protected by fuses mounted near the tap off point from the main connections.

9.0 SURFACE TREATMENT

The each part of the fabricated panel will be subjected to seven tank treatment and all sheet metal accessories and components of power control centres and switchboard panels shall be thoroughly cleaned, degreased, de-rusted and hot dip phosphatised before red oxide primer is applied. The panel shall be stove enamelled Gray shade finish and the Interior surfaces of the panel shall be painted to an off-white shade.

10.0 ENCLOSURE

The panel enclosure shall be totally dust and vermin proof and shall be suitable for indoor installation. All the cubical will be adopted with front located, outward openings, lockable doors having hidden hinges and a bolted back cover both using no deteriorating neoprene rubber gasket. Enclosure design shall be in accordance with degree of protection IP 54 as per IS : 13947. All the nut bolts handles, meters, knobs etc. appearing from out side of the panel should be located in symmetry so as to give a neat appearance.

11.0 NAME PLATE

The panel as well as the feeder compartment doors shall be provided with name plate giving the switchboard/feeder descriptions as indicated on the drawings. The above shall be mounted in metal holder with a clear plastic sheet on inside surface of the front door.

12.0 TESTING

The power control centres shall be tested at factory after assembling of all components and completion of all interconnections and wiring. Tests shall be conducted in accordance with the requirements of BS:3659.

Insulation Test

a) Insulation of the main circuit, i.e. the insulation resistance of each pole to the earth and that between the poles shall be measured.
b) Insulation resistance to earth of all secondary wiring should be tested with 1000 volt meggar.

Insulation test shall be carried out both before and after high voltage test.

High Voltage Test

A high voltage test with 2.5 KV for one minute shall be applied between the poles and earth. Test shall be carried out on each pole in turn with the remaining poles earthed, all units raked in position and the breakers closed. Original test certificate shall be submitted along with panel.

13.0 STORING, ERECTION AND COMMISSIONING

a) The panels shall be stored in a well ventilated, dry place, with a suitable polythene covers shall be provided for necessary protection against moisture.

b) **Erection**

Switch boards shall be installed on suitable foundation. Foundation shall be as per the dimensions supplied by the panel manufacturer. The foundation shall be flat and levelled. Suitable grouting holes shall be provided in the foundation. Suitable MS base channel shall be embedded in foundation on which the panel can be directly installed. The switch boards shall be properly aligned and bolted to the foundation by at least four bolts. Cables shall be terminated on the bottom plate or top plate as the case may be, by using high quality brass compression glands. The individual cables shall then be led through the panel to the required feeder compartments for necessary termination's. The cables shall be clamped to the supporting arrangement. The switchboard earth bus shall be connected to the local earth grid.

c) **Pre-commission Tests**

Panels shall be commissioned only after the successful completion of the following tests. The tests shall be carried in the presence of Architect's/Consultant's or their representatives.

i) All main and auxiliary bus bar connections shall be checked and tightened.

ii) All wiring termination and bus bar joints shall be checked and tightened.

iii) Wiring shall be checked to ensure that it is according to the drawing.

iv) All wiring shall be tested for insulation resistance by a 1000 volts megar.

v) Phase rotation tests shall be conducted

vi) Suitable injection tests shall be applied to all the measuring instruments to establish the correctness and accuracy of calibration and working order.

vii) All relays and protective devices shall be tested for correctness of settings and operation by introducing a current generator and an ammeter in the circuit.

F) METERING, INSTRUMENTATION AND PROTECTION

1.0 The specifications hereinafter laid down shall cover all the meters, instrumentation and protective devises required for the electrical work. The ratings, type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities and drawings.

Measuring Instruments
General

Direct reading electrical instruments shall be in conformity with IEC-51, BS: 89 or IS: 1248. The accuracy of direct reading shall be 1.0 for voltmeters and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meters shall be suitable for continuous operation between 10°C ± circular pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instrument glass. Instrument meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale marking. The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right. Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three phase supply.

a) **Ammeters**

Ammeters shall be moving iron type. The moving part assembly shall be with jewel bearings. The jewel bearing shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks. The ammeters shall be manufactured and calibrated as per the latest edition of IS 1248 or BS 89. Ammeters shall be instrument transformer operated, and shall be suitable for 5 A. Secondary of instrument transformer. The scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

b) **Voltmeters**

Voltmeter shall be of moving iron type. The range for 400 volts, 3 phase voltmeters shall be to 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the system. The voltmeter shall be provided with protection fuse of suitable capacity.

2.0 INSTRUMENT TRANSFORMERS

Current Transformers

Current transformers shall be in conformity with IS:2705 (Part-I, II, & III) in all respects. All current transformers to be used in the L.T. Electrical panels shall be low tension, ring type resin cast current transformer with the requisite currents ratio having secondary of the current transformers selected will be based on the following;

1. For energy measuring : 1.0 class of accuracy.
2. For other metering : 1.5 class of accuracy.
3. For protects on : 3.0 class of accuracy. Where a common CT is used for different functions the CT accuracy class will be equal to the best class required by any of those function.

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 35 MVA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Current transformers shall be provided with earthing terminals for earthing chassis frame work and fixed part of the metal casing (if any). Each CT shall be provided with rating plate indicating the following:

1. Name and make
2. Serial Number
3. Transformation ratio
4. Rated burden
5. Rated voltage
6. Accuracy class

The current transformers to be selected for this panel will have at least 20% extra VA capacity available over the normal capacity based on the following details ;

1. For ammeters : 3 VA
2. For current coils of KW & KWHR, PF, KVAR meters or for all recorders : 5 VA.
3. For normal wiring : 2 VA.
4. For current coil of protection relays : 10 VA under no circumstances the VA rating of the CT's will be less than 15 VA.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CTs shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

3.0 WATT METERS, FREQUENCY METERS, POWER FACTOR METERS

i) Watt Meters : Watt meters shall be of three phase, electro-dynamic type, suitable for use with current and potential transformers associated with the particular panel. Watt meters shall be provided with a maximum demand indicator.

ii) Power factor meters : Polyphase power factor meters shall be of electro-dynamic type with current and potential coils suitable for operation with current transformers and potential transformers associated with the particular panel. The scale shall be calibrated for 50% lag - 100% - 50% lead readings. Phase angle accuracy shall be + 4^{O}.

iii) Energy meters and reactive power meters : Trivector meters shall be two element, integrating type kilowatt-hour, KVA, Kilovolt - ampere - hour reactive meters. The meters shall conform to IEC - 170 in all respects. Energy meters, KVA and KVARH meters shall be provided with integrating registers. The registers shall be able to record energy consumption of 500 Hours corresponding to maximum current at the rated voltage and unity power factor. These meters shall be suitable for operation with current and potential transformers associated with the particular panel.

4.0 CONTROL DEVICES

a) Push Buttons

The push buttons used in the panels will be rated for more than 415 volts and 2 amps. All the push buttons will be mounted on the front door and the assembly will be in two parts. All the push buttons will be mounted on the front door of the cubicle in regular symmetrical fashion as per the general norms being practiced. Only one make of push buttons will be used in the assembly of all the panels. The selection of the colour of the push buttons will be as follows

Function	Colour
Starting/Switching ON	Green
Stopping/Switching OFF	Red
Resetting	Black
Forward ON	Yellow
Reverse ON	Blue
Emergency OFF	Red/Mushroom

b) Indicating Lights

The indicating lights used in the panel will be pleasant looking and round shape having the following features;

1. A separate front lens for it's easy replacement.
2. Facility to replace the bulb from the front.
3. Bay net pin cap bulbs of standard size to be used.
4. The shape of the lens to allow viewing from sides.
5. Series resistance with use of low voltage bulb for longer life.
6. Clear and distinct indication for light ON and OFF with differences of brightness of the lens.

The selection of the colours of the indicating lamps will be as follows:

- Red for system in operation
- Amber for system ready for operation.
- Green for system being put off.
- Red, yellow and blue for incoming supply.

5.0 TESTING

5.1 Instrument transformers shall be tested at factory as per IS:2705 & IS:3156. The test shall incorporate the following:

a) Type tests
b) Routine tests

Original test certificates in triplicate shall be provided.

5.2 Meters shall be tested as per IS: 1248. The tests shall include both type tests and routine tests. Original test certificate in triplicate shall be furnished.

5.3 a) Suitable injection tests shall be applied to the secondary circuit of every instrument to establish the correctness of calibration and working order.

b) All relays and protective devices shall be tested to establish correctness of setting and operation by introducing a current generator and an ammeter in the circuit.

G) MOULDED CASE CIRCUIT BREAKERS/ACB

1.0 GENERAL

Moulded case circuit breakers shall be incorporated in the switch board wherever specified. MCCB shall conform to IEC:947-II or IS:13947-II in all respects. MCCB shall be suitable for three phase 415 volts AC. Suitable discrimination shall be provided between upstream and down stream breakers in the range of 10-20 milli seconds. All MCCBs will have earth fault module (if specifically asked) and front operated. All four pole MCCB shall be suitable for three phase four wire system, with the neutral clearly identified and capable of first make last break feature.

2.0 CONSTRUCTION

The MCCB cover and case shall be made of high strength heat-resistant and flame retardant thermosetting insulating material, operating handle shall be quick make/quick break. The operating handle shall have suitable `ON' `OFF' and `TRIPPED' mechanical indicators notable from outside. All MCCBs shall have a common operating handle for simultaneous operation and tripping of all the three phases. The MCCB should be suitable for disconnection and isolation with marking on front name plate.

Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be thermal-magnetic type provided on each pole and connected by a common trip bar such that tripping of any one pole operates all three poles to open simultaneously. Thermal magnetic tripping device shall have IDMT characteristics for sustained over load and short circuits. All MCCBs above 250 Amps will also have short circuit magnetic pickup level adjustment.

MCCBs/ACBs

All MCCBs/ACBs shall have variable electronic releases from 50% to 100% which can be adjusted at site.

3.0 Contact tips shall be made of suitable arc resistant, sintered alloy for long electrical life. Terminals shall be of liberal design with adequate clearances. All MCCBs of higher ratings above 250 Amps, shall be provided with separate extended arcing contacts.

4.0 INTERLOCKING

Moulded case circuit breakers shall be provided with the following interlocking devices for interlocking the door of a switch board.

a) Handle interlock to prevent unnecessary manipulations of the breaker.

b) Door interlock to prevent the door being opened when the breaker is in ON or OFF position.

c) Defeat-interlocking device to open the door even if the breaker is in ON position.

5.0 BREAKING CAPACITY

The moulded case circuit breaker shall have a rated service. Short circuit breaking capacity of not less than 25 KA rms at 415 volts AC. Wherever required, higher breaking capacity breakers to meet the system short circuit fault shall be used.

6.0 ACCESSORIES

All the accessories like shunt, under-voltage contact blocks shall be of snap fitting possible at site.

7.0 TESTING

a) Original test certificate of the MCCB shall be furnished.

b) Pre-commissioning tests on the switch board panel incorporating the MCCB shall be done as per standard specifications.

J) TRANSFORMER:

1.0 TRANSFORMER (Oil TYPE)

1.1 Scope :

This standard specification covers the general requirements for the design, manufacture, testing and supply of indoor dry type transformers (having general requirements listed in following paragraphs). This specification is accompanied by the transformer data sheet.

1.2 Standards:

The dry type transformer shall comply with the applicable clauses of the latest editions of following standards. In case of any conflict, the requirements of this standard specification shall prevail.

IS:3639	Power Transformer Fittings & Accessories.
IS:2026 (Part-I to IV)	Power Transformers

IS:11171	Power Transformer accessories.
CBIP Specification Part-II	Power and Distribution Transformers

1.3 Constructional Details:

1.3.1 The transformer shall be oil type, ANAN cooled suitable for indoor installations. This shall be provided with welded sheet steel, free-standing enclosure with expanded metal screens of suitable size or louvers backed by wire-mesh. Transformer and upper body shall be suitably reinforced to prevent distortion during handling. Base channels shall be provided with skids and pulling eyes to facilitate handling.

1.3.2 All the fasteners and bolts shall be hot dip galvanized or zinc passivated.

1.3.3 The transformer shall be double wound core type with cold rolled grain oriented silicon steel laminations perfectly insulated and clamped to minimize vibrations and noise. Core fastening bolts shall be insulated to reduce losses and avoid hot spots. All parts of the magnetic circuit shall be effectively connected to earth system.

1.3.4 The winding shall be copper and shall be designed for full load current to withstand the thermal and electromagnetic stresses arising due to maximum fault level. The current carrying winding joints shall be electrically brazed.

1.3.5 The winding shall be provided with Class-"F" & above.

1.3.6 The transformer shall be designed with particular regards to suppression of harmonic voltages.

1.4 Terminals & Marshaling Box:

1.4.1 Winding shall be brought out and terminating on outdoor bushings, cable boxes or bus duct chamber which will be located as specified on data sheet.

1.4.2 Cable boxes shall be supplied with cable lugs and glands. H.T. cable box shall be suitably dimensioned to accept terminations of XLPE cable 3C x 240 Sqmm from top entry specified in data sheet.

1.4.3 The H.V./L.V. terminal boxes shall be located on the side/top respectively and at right angle or opposite to each other as specified in the data sheet. Suitable cable chamber shall be provided for cable termination on LV side for 7 x 3.5 x 300 Sqmm Cable.

1.4.4 Cable lugs shall be non-soldering, crimped type.

1.4.5 Terminal chamber for cable termination shall have a gasketted cover plate bolted to it. A separate cover plate shall be provided to facilitate the connection and inspection. Phase sequence of busbar shall be as specified in Data Sheet.

1.4.6 Marshaling box shall be weather-tight. All protective devices and neutral CTs shall be wired by means of PVC insulated armored cables up to marshaling box. Terminals shall be Elmex type or approved equal.

1.4.7 Provision of terminating cable on secondary side to be made and accordingly secondary winding shall be brought to the terminal chamber.

1.5 Testing:

Purchaser's representative shall be given free access in the works from time to time for stage-wise inspection and progress reporting. The following routine and type tests shall be performed on the transformers as per IS:2026 in the presence of purchaser's representative and certified test reports submitted. About three week's notice shall be given to the purchaser to witness the tests at the vendor's works.

1.5.1 Routine Tests:

The routine tests, including but not limited to the following shall be performed on each of the transformers, as per the relevant standards.

i. Measurement of winding resistance.

ii. Measurement of voltage ratio and check of voltage vector relationship.

iii. Measurement of impedance voltage/short circuit impedance and load loss.

1.5.2 Type Tests Optional at Extra Prices):
The transformer manufacturer should have tested 'Dry Type' transformer of rating 1500 KVA or above for 'Dynamic Short Circuit' at Independent Govt. Test Laboratory within last 2 years'.

1.6 Accessories:

Accessories as specified in the attached Data Sheet shall be included in the scope of supply.

The tapping and control gears shall be provided on the H.V. side. Tap changer shall be off-circuit type as specified in Data Sheet. The tap charging equipment shall be suitable for carrying the fault current.

Earthing Terminals

Two earth terminals of adequate mechanical and electrical capacity shall be provided. One separate earthing terminal shall also be provided on each separate radiator banks.

Buchholtz Relay

Double float Buchholtz relay where specified shall have two separate sets of contacts, one for alarm and other for circuit breaker trip. The relay shall have a test cock. A small window in the wall of the relay shall be provided to show the amount of the trapped gas, it any. The construction of the transformers shall be such that all rising gas will be readily reach the Buchholtz relay. Gas sampling device at an accessible height and an air release cock for Buchholtz relay shall be provided.

Winding Temperature Indicator (WTI)

Shall comprise of :

i. Temperature sensing element
ii. Image coil
iii. Bushing or turret mounted C.T.
iv. Local indicating instrument with electrically independent trip/alarm contact brought out to separate terminals.

1.7 Painting:

All metal parts shall be thoroughly cleaned to remove rust, scale, grease etc. and painted with two coats of approved colour shade over one coat of rust resisting primer. The paint shall not scale-off, crinkle or removed due to normal handling.

All metal surfaces not accessible for painting shall be made of corrosion resistant material.

1.8 Rating Plate Details:

Each transformer shall be provided with a rating plate giving the details as per IS:11171. The marking shall be indelible and the rating plate shall be located on the front side.

Exact value of transformer % impedance, as determined by tests shall be marked on it and also on the final submission of nameplate.

1.9 Drawing & Documents:

i. All drawings and documents shall be submitted as per the requirements specified in vendor data.

ii. Complete technical particulars as per Appendix-B of IS:11171 as applicable to Dry Type Transformers shall be furnished with the quotation.

iii. Make and type of various accessories and protective devices shall be furnished with the quotation.

1.10 Guarantee:

The transformer shall be guaranteed for trouble-free service for the period of 12 months from the date of commissioning or 18 months from the date of receipt at site, whichever, is earlier. Any defects discovered during this period shall be rectified free of charge.

1.11 Information Required with Bids:

1.11.1 Clause-wise deviations to this specification. If the same are not furnished it will be assumed that the offered equipment meet the enquiry specifications in toto.

1.11.2 Information as sought in clause 10.0
1.11.3 GA drawing of each rating covered in BOQ.
1.11.4 True un priced copy of the priced bid.

TRANSFORMER DATA SHEET

1.0 GENERAL

1.1	Application	:	Power Distribution
1.2	Quantity Required	:	1 No.
1.3	Installation	:	Outdoor

2.0 RATINGS

2.1	Rating KVA	:	200
2.2	Number of phases & Frequency	:	3 PHASE, 50Hz
2.3	Type of cooling	:	ONAN
2.4	No Load Voltage		
2.4.1	HV	:	11000 V
2.4.2	LV	:	415 V
2.5	Vector Group	:	DYn11
2.6	Percentage Impedance	:	

3.0 VOLTAGE:

3.1	Nominal System Voltage		
3.1.1	HV	:	11000 V
3.1.2	LV	:	415 V
3.2	Highest System Voltage		
3.2.1	HV	:	12000 V
3.2.2	LV	:	415 V

4.0 TAPCHANGING GEAR:

4.1	Taps ON/OFF Load	:	OFF Load Tap changing Links.
4.2	Tapping on windings HV/LV	:	HV
4.3	Total tapping range	:	+5% to –15%
4.4	Steps	:	6

5.0	**TEMPERATURE RISE**		
5.1	Ref. Ambient ^{O}C	:	$45^{O}C$
5.2	Winding by Resistance ^{O}C	:	$90^{O}C$
6.0	**INSULATION WITHSTAND**		
6.1	Impulse (1.2x50 micro second wave)	:	75 KV
6.2	Power Frequency (Dry & Wet)		
6.2.1	HV	:	28 KV
6.2.2	LV	:	3 KV
7.0	**NEUTRAL EARTHING**		
7.1	**System Neutral**		
	Effectively Earthed/Resonant Non effectively Earthed/Isolated	:	Effectively Earthed
7.2	Neutral	:	Effectively Earthed
8.0	**ACCESSORIES:**		
8.1	Winding Temperature Indicator	:	Yes
8.2	Buchholtz Relay	:	Yes
8.3	Wheels Plain/Flanged / bidirectional / unidirectional	:	Plain, Bidirectional
9.0	**TERMINATION ARRANGEMENT**		
9.1	H.V. Side (Cable Box)	:	Cable box and disconnecting chamber suitable for 3C x 120 Sqmm 11 KV XLPE cable with top entry.
9.2	L.V. Side (Cable)	:	Cable box and disconnecting chamber for 1 x 3.5 x 300 $mm^{2.}$
10.0	Paint Shade	:	Dark Green.
11.0	Limit Switch for Interlocking access to tapping links.		
12.0	Enclosure	:	Out door Type

DATA TO BE FURNISHED BY BIDDER

1.0 TRANSFORMER:

1.1	Name of Manufacturer	:
1.2	Standards followed in design manufacture and testing	:
1.3	Continuous maximum rating in KVA	:
1.4	Transformer no-load voltage	
1.4.1	High voltage	:
1.4.2	Low voltage	:
1.5	Vector group reference	:
1.6	Terminal Arrangement	
1.6.1	H.V. Side	:
1.6.2	L.V. Side	:
1.7	One-minute dry power frequency test withstand voltage in KV	:
1.7.1	High voltage	:
1.7.2	Low voltage	:
1.8	Impulse test withstand voltage with 1.2 x 50 microseconds wave in KV	:
1.9	Type of tap changer	:
1.9.1	No. of plus taps	:
1.9.2	No. of minus taps	:
1.10	Iron losses in KW at rated voltage and frequency	:
1.11	Copper losses in KW at rated full load current and frequency at 75 ^{O}C	:
1.12	Reactance voltage with guaranteed tolerance in percent at rated full load current and frequency 75 ^{O}C	:
1.13	Impedance voltage with guaranteed tolerance in percent at rated full load current and frequency at 75 ^{O}C	:

1.14	Regulation in percent of no-load voltage at full load current at 75 degree C and with power factors of	:
1.14.1	Unity	:
1.14.2	0.8 lagging	:
1.15	Efficiency in percent at 75 ^{O}C and unity power factor for	:
1.15.1	100 percent load	:
1.15.2	75 percent load	:
1.15.3	50 percent load	:
1.16	No-load current in amperes at rated voltage and frequency	:
1.17	Inrush magnetizing current in percent of normal full load current.	:
1.18	Details of winding insulation	:
1.18.1	Class of insulation materials	:
1.18.2	Turns insulation high voltage in mega ohm	:
1.18.3	Turns insulation low voltage in mega ohms	:
1.18.4	Insulation core to low voltage in mega ohms	:
1.18.5	Insulation high voltage to low voltage in mega ohms	:
1.19	Details of 415 V neutral current transformer	:
1.19.1	Name of manufacturer	:
1.19.2	Current ratio	:
1.19.3	VA capacity	:
1.19.4	Accuracy & performance characteristics	:
1.20	Weights	
1.20.1	Core and windings in kg	:
1.20.2	Complete transformer	:
1.21	Overall Dimensions	:
1.21.1	Length in mm	:

1.21.2 Breadth in mm :

1.21.3 Height in mm :

2.0 TESTS:

2.1 List of tests proposed to be carried out at the factory :

2.2 List of tests proposed to be carried out at the site before commissioning :

INFORMATION TO BE FURNISHED BY THE VENDOR AFTER AWARD OF CONTRACT

Information to be furnished within 2 weeks of award of contract.

1.0 Positive sequence impedance at maximum voltage tap.

2.0 Positive sequence impedance at minimum voltage tap.

3.0 Zero sequence impedance at principal tap.

4.0 Efficiency at 75^{O}C winding temperature:

4.1 At full load
4.2 At 75% full load
4.3 At 50% full load

5.0 Maximum efficiency and load at which it occurs.

6.0 Regulation at full load at 75^{O}C winding temperature at:

6.1 Unity power factor
6.2 0.85 power factor lag.

7.0 Resistance per phase of :

7.1 H.V. winding : Ohms
7.2 L.V. winding : Ohms

8.0 Conductor area (sq.cm) and current density (Amps/cm2)

8.1 HV winding
8.2 LV winding

9.0 Type of windings

9.1 HV
9.2 LV

10.0 Insulating materials for interturn insulation :

10.1 HV winding
10.2 LV winding

11.0 Insulating materials for winding insulation

12.0 Insulating materials

12.1 Winding and core

12.2 Laminations of the core.

13.0 Make, type, dial rise, number of contacts and contact ratings (current following items, if provided).

13.1 Dial type thermometer.

13.2 Winding temperature indicator.

14.0 Thermal withstand capability under full short circuit conditions in terms of number of times of calculation of short circuit and corresponding anticipation percentage reduction in transformer life. Relevant calculations shall be submitted.

15.0 DRAWINGS

The following drawings shall be submitted to Engineer-in-charge for approval in the stipulated time.

		Weeks after award of contract
15.1	General outline drawings showing plan, front elevation, rear elevation, cable boxes / disconnecting chamber section views, location & dimensions of cable entries, terminals foundation floor fixing details and weights.	1
15.2	Bushings: Plan, elevation terminals details, mounting details make and type number, current and voltage rating, creepage distances and principal characteristics.	1
15.3	Rating and diagram plate	1
15.4	Marshalling box terminal connections, wiring diagram	2

16.0 TEST REPORTS

Test results shall be corrected to a reference temperature of 75 ^{O}C.

16.1 Two copies of test results shall be submitted for the Owner's/Consultants approval before despatch of transformer.

16.2 Additional bound copies, as required by the Owners/Consultants contract, of complete test results including all tests on transformer, bushing, current transformer (if provided), shall be furnished with the transformer.

K) DIESEL GENERATOR SETS:

1.0 INTENT OF SPECIFICATION:

1.1 This specification covers the design, manufacture, assembly, shop testing, packing, dispatch, transportation supply, erection, testing, commissioning, performance and guarantee testing of **Diesel Gen-Sets,** complete in all respects with all equipment, fitting and accessories for efficient and trouble free operation as specified here under.

2.0 SCOPE OF WORK:

2.1 Scope of Supply & Services:

General Scope of work shall include design, manufacture, shop testing, packing, dispatch, transportation to site, supply, erection, testing and commissioning of the following:

a) Diesel engine complete with all accessories, an Alternator directly coupled to the engine through flexible/rigid coupling complete with all accessories for starting, regulation and control, including base frame, foundation bolts etc. interconnecting piping and accessories, power and control cable glands and lugs.

b) Diesel Local/Remote control panel including cables between bidders local equipment and special cables if any.

c) Equipment necessary for engine cooling system, radiators, pumps, valves, inter connecting pipes etc.

d) Equipment necessary for fuel storing and distribution, day oil tank (990 Lt.), pipings, pumps, valves, level indicators etc.

e) Flexible connections and residential type silencer of exhaust system, including thermal lagging.

f) Batteries with iron battery stand and battery charging equipment, including their connections as necessary along with tools & accessories for battery maintenance.

g) Anti Vibration Mountings etc.

h) Preparing all related shop drawings for approval from client/consultant and statutory bodies.

i) Obtaining approval of the installation of Diesel Generators by the Electrical Inspectorate and Pollution Control bodies and any other statutory bodies.

j) Minor civil works like chasing, grouting etc. for execution of jobs.

k) Carrying out performance and guarantee test including making arrangements for loads etc. as required.

2.2 Specific Exclusions:

Following items of works are excluded from the scope of works under this specification:

a. All civil works relating to DG foundation etc.

b. All cables between contractors and owners equipment other than special cables external to the equipment.

3.0 CODES AND STANDARDS:

3.1 The equipment furnish under this specification shall conform to the following latest standard, except where modified or supplemented by this specification:

BS:5514	:	Specification for reciprocating internal combustion engine.
BS:5000	:	Rotating electrical machines of particular type or for particular applications.
IS:1239 (Part-I & II)	:	Mild steel tubes and fittings.
IS:1651	:	Stationary cells and batteries lead acid type (with tubular positive plates).
IS:9224	:	Specification of low voltage fuses, General Purpose.
IS:4540	:	Mono-crystalline semi-conductor rectifier assemblies and equipment.
IS:5	:	Colours for ready mixed paints.
IS:4722	:	Rotating electrical machines
IS:1248	:	Specification for electrical indicating instruments.
IS:10000	:	Methods of tests for internal combustion engines.
IS:10002	:	Specifications for performance requirements for constant speed compression ignition (Diesel) engine for general purposes (above 20 KW).
IS:2147	:	Degree of protection provided by enclosure for low voltage switchgear and control gear.
IS:1600	:	Code for type testing of constant speed IC engines for general purposes.
IS:1601	:	Performance of constant speed IC engines for general purposes.
ASME Power	:	Internal combustion engines.

Test Code PTC-17

Codes of Diesel Engine Manufacturer's Association U.S.A.

3.2 The installation work shall conform to Indian Electricity act and Indian Electricity Rules as amended upto the date of installation.

The fuel oil installation shall meet all statutory requirements of Govt. of India as amended upto the date of installation. Any approval required from statutory authorities shall be obtained by the Contractor. Nothing in this specification shall be construed to relieve the contractor of these responsibilities.

3.3 The Indian standards mentioned above are available from:

Indian Standards Institution
Manak Bhawan,
9, Bahadur Shah Zafar Marg,
New Delhi - 110 002 (INDIA).

3.4 The Indian electricity Rules and the Electricity act mentioned above can be obtained from:

Kitab Mahal,
State Emporium Building,
Baba Kharak Singh Marg,
New Delhi - 110 001 (INDIA).

3.5 Equipment conforming to any other National/International Standard which ensures equal or better quality may be accepted. In such case the bidder shall furnish copies of the standards in English along with his bid and shall clearly bring out the salient features of comparison with corresponding listed standards.

3.6 The equipment furnished under this specification have to operate in a tropical climate and shall be given tropical and fungicidal treatment as per relevant specification

3.7 Period of Operation/Duty Cycle:

The sets are intended to supply power only during an emergency for essential services and may be idle for long periods except for periodic routine tests once in a week. When there is a total failure of main power supply, the sets shall be required to operate continuously at full load for a period which at times may exceed even 24 hours.

4.0 ENGINE:

4.1 Type:

The diesel engine shall be of stationary type four stroke/two stroke with vertical in line or (V) type cylinder arrangement, Turbo-charged, cooled with radiators.

4.2 Rating:

a. Continuous BHP rating of the engine shall be such that the DG set can continuously deliver the specified net electrical output while supplying power/driving all electrical and mechanical auxiliaries connected to alternator terminals and engine shaft at specified site conditions and ambient temperature of $45^{O}C$.

b. It shall also be capable of satisfactorily driving the alternator at 10% over load at the rated speed for one hour in any period of 12 hours of continuous running.

The successful contractor shall have to furnish supporting calculations to arrive at diesel engine rating.

4.3 Speed and Vibration Levels:

a. Speed shall be 1500 revolutions per minute. Speed governor/over speed protection shall be provided.

At due running conditions, speed shall be stabilized at plus or minus 2% nominal speed, regardless of load. At transient condition, engine speed shall vary not more than 10% plus or minus. Governor class shall be A2 (4% drop) for normal application unless otherwise specified.

b. The engine vibration level shall not exceed 100 microns.

4.4 Lubrications:

a. The engine shall have a closed cycle forced & splash lubricating system with positive oil pressure and a crank chamber for collection/storage of the lubricating oil during circulation. No moving part shall require lubrication by hand or any other external source either prior to the starting of the engine or when it is in operation.

b. A lubricating oil filter shall be provided for operation under normal conditions for a period of more than 250 hours without the necessity of its replacement or cleaning.

c. In case lubricating oil coolers are required they shall be of the air cooled type and shall be supplied as an integral part of the Diesel Generator Set.

d. Necessary temperature and pressure gauges and other instruments shall be supplied and fitted on the lubrication system.

e. A lubricating oil level dipstick suitably graduated shall be provided and located in the accessible position.

4.5 Fuel System:

a. The engine shall be capable of running on all types of diesel fuel oil normally available in India.

b. The fuel consumption of the engine at full, three quarters and half of its rated power output shall be indicated by the Contractor in the bid.

c. A fuel service tank, common for two DG set with 990 litres capacity shall be provided on a suitably fabricated steel platform. The tank shall be complete with level indicator marked in litres, filling inlet with removable screen, an outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. Service tank level switches (2 Nos. per tank) for alarm & trip shall also be provided by the bidder. All pipe joints should be brazed/welded.

d. A hand pump for pumping the fuel into the fuel service tank together with necessary pipes or tubing shall be provided. The inlet of the pump shall be provided with 5 metres long armoured hose with suitable filter.

4.6 Air Intake System:

The diesel engine shall be provided with special dry type air filters having low resistance to air passage, high dust retaining efficiency and provision for easy cleaning. Filters shall be suitable for achieving satisfactory engine operation and ensuring the engine life under tropical humid conditions, with sulphur dioxide fumes, abrasive dust and coal particles of 5 to 100 microns present in the atmosphere. The minimum efficiency of filters shall be 90% down to 5 micron size.

4.7 Cooling:

The diesel engine should be water cooled with heat exchanger and radiator system. The cooling system should include temperature gauge with high temp., alarm/trip corrosion resistor etc.

4.8 Engine Governor:

The governor shall be Electronic ISO-Chronous type to maintain zero speed rate or regulation and shall be Al type as per BS:5514 in order to take care of heavy motor starting. It shall have necessary characteristics to maintain the speed substantially constant even with sudden variation in load. However, a tripping shall be provided if speed exceeds maximum permissible limit. The governor shall be suitable for operation without external power supply.

4.9 Turbo Charger:

It shall be of a robust construction, suitable of being driven by engine exhaust having a common shaft for the turbine and blower. It shall draw air from filter of adequate capacity to suit the requirements of the engine.

4.10 Quietness of Operation:

a. The engine shall be designed to achieve maximum quietness of operation.

b. Efficient industrial silencer shall be provided for the exhaust as well as the air intake.

c. Noise level of the set shall not exceed 93DB at one meter distance of the engine.

4.11 Engine Starting:

a. Engine starting shall be by electric starting motor complete with manual/automatic starting arrangement. The starter motor shall conform to IS:4722 and shall be of adequate power for its duty and be of inertia or pre-engaged type. The pinion shall positively disengage when the engine starts up or when the motor is de-energized. The engine cranking shall be only from the panel both for AMF & DG sets (Manual) and any engine starting devices etc. that are given as original fitment on the engine by engine manufacturers shall be either removed or padlocking arrangement given for this so that all normal start/stop operations could be done only from panel whether the set is AMF or manual.

   The engine wiring shall be appropriately modified, ferruled to totally match with schematic drawings of the panel.

b. Time for Run-up to Speed:

   From the initial operation of the starting device, the engine shall start, run up to normal speed and be capable of accepting 80% of full load within a maximum time of 25 seconds, and full load within a further 5 second.

4.12 Starter Battery:

a. The battery shall conform to the requirement of IS:1651. Starting battery sets of 24 V, heavy duty high performance approved make/quality shall be provided to enable crank & start the engine even in cold/winter morning conditions. Type/voltage/AH capacity of same on 20 hour rated discharge period shall be indicated in the offer. The battery shall be capable of performing at least (6) six normal starts without recharging.

b. The battery shall be provided with good quality teakwood stand painted with acid proof black paint with min 3mm thick rubber mat below the batter.

c. Batteries shall be of load container type only and not with PVC moulded sealed container so that each individual cells are available for individual monitoring during its life span. Each cell shall be provided with electrolyte filling cap with level floats for easy monitoring of electrolytic level.

d. For each battery system following accessories shall be provided:

   1. PVC Funnel - 1 No.
   2. Small PVC mugs with handle - 2 Nos.
   3. Hydrometer syringe type with float calibrated (not with zero markings only) with one spare float.
   4. Centre zero voltmeter good quality with 3V-0-3V scale.
   5. PVC Jerry-can white colour with tested quality distilled water, with can clearly marked with engraved PVC inscription plate “Distilled Water”.
   6. One tin of petroleum jelly (500 gms)
   7. Painter brush 1” wide - Nos.

e. The battery shall be provided with 2 Nos. cables, minimum 1.5m long heavy duty rubber/PVC insulated cabling with brazed tinned lug at one end and with brazed tinned brass terminal lug at battery end - for connecting batteries to cranking system - with 0.25 m long inter battery connecting cable.

f. The lugs shall be clearly stamped (+) or (-) and positive cable also red sleeved for easy identification.

g. The batteries shall be supplied fully filled and first charged ready to use.

4.13 Battery Charging System:

a. Float rate charging and quick rate charging system shall be provided at the generator panel with appropriate bridge charger system, LC network, rate selector switch and generously rated charging transformer and silicon one rectifier bridge, so that the cranking battery system can be kept fully charged at all times from E.B. supply network with quick charging rate limited to 0.8 times rated discharge current with provision in control transformer and Si rectifier present to enable boost charging the battery at 2 times rated discharge current in case of emergencies. To this and in the mode selector switch boost charge position shall be present which however shall be kept disconnected at mode selector switch normally.

b. Two DC ammeters to clearly indicate float charging current and quick/boost charging current shall be provided with 0-250 or 0-500 mA range and 15-0-15 or 30-0-30 A range respectively.

c. The float charging ammeter circuit logic shall be so as to bring at in ckt only on demand through a P.B. provided the R.S.S. (Rat Selector Switch) in it float charging mode to prevent damage to the ammeter.

d. Dropper resistor network on the load side of battery charger system shall be provided so that higher charger voltages in quick or boost conditions does not get impressed on the I/L and Contactor coils, which voltage shall remain well within +10% of rated voltage.

e. Battery charging subsystem shall be designed for continuous operation at cubicle ambient of $50^{O}C$ corresponding to $45^{O}C$ ambient outside and should be designed to operate at 1.5 times rated maximum current corresponding to boost charge current which can reach in practice as high as 2.5 times or 3 times rated discharge current.

f. Any charger dynamo and dynamo charging current network present on the set shall either have to be removed or made in operative so that both for AMF and manual application the cranking battery system is kept charged from the charger at the panels at all times during or shut down periods of the set.

g. To the above and in case of manual DG sets, the input to charger subsystem viz., 240 V AC is foreseen to be provided from customer network from the portion that is normally supplied by manual DG Set during DG operation or being fed by E.B. System.

4.14 Engine Fitments:

The engine shall be provided with but not limited to following essential basic fitments:

- Cranck case breather - Dry type element.
- Air Cleaner - Dry type mounted.
- Corrosion resistor - to control acidity and impurities from

coolant.

- Lubricating Oil Cooler -
- Filters - Lub oil & fuel oil, paper element type.
- Coolant Pump -
- Fuel Pumps - Priming & Transfer
- Governor - Hydraulic or hydro-mechanical type class.
- Turbo Charger - Exhaust gas driven in case of turbo charged engines.
- Flywheel with flywheel housing - SAE Type
- Flexible Coupling - Spider type
- Vibration dampers - One Set
- Exhaust/Intake manifolds -
- Oil Sump (crank case) with dip stick
- Engine Supports
- Residential type silencer in exhaust system
- Electrical starter 12 V or 24 V
- Safety controls & instruments

4.15 Engine Instrumentation:

The following instruments mounted on instrument panel shall be essentially present as minimum:

- Engine speed tachometer with service hour counter
- Lub oil pressure gauge
- Lub oil temperature gauge
- Coolant water temperature gauge

The instrument panel shall be mounted on engine using rubber dampers for vibration isolation.

The gauge dials shall have clear red marking to identify the limiting dangerous levels, `Zone Markings' on the scale to indicate the normal healthy & abnormal operating zones for the parameters concerned.

The metering could be either normal electro-mechanical analogue type or electronic digital type, latter being preferred as manufacturers fitment only.

5.0 ALTERNATOR:

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

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

5.3 The alternator shall conform to IS:4722/BS:2613 and shall be suitable for tropical conditions.

5.4 The alternator shall comply with the following specifications:

Rating	-	125 KVA (1 No.) (Shall be capable of 10 % over loading at the rated speed for one hour of 12 hours continuous running.
Voltage	-	415 V
Speed	-	1500 RPM
Frequency	-	50 Hz.
P.F.	-	0.8 lag
Enclosure	-	IP:23
Insulation	-	F (shall be of epoxy thermosetting type but limited to class `B' operation from temperature rise consideration.
Execution	-	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 size 1 x 3.5 C x 240 Sqmm
Earthing Studs	-	4 Nos.

5.5 Neutral Point:

The winding of the alternator shall be star-connected and the neutral side leads shall be brought out to a separate terminal Box CT's shall be provided on neutral side of each phase for alternator differential protection.

The neutral side C.T. parameters will be as below:

Ratio	-	400/5, 200/%A
KPV at least equal to	-	150 V
Class	-	PS
RCT not more than	-	1.5 Ohms

5.6 Terminal Box and Connection:

The alternator output terminals shall be enclosed in a terminal box mounted in an accessible position on the alternator frame. As far as possible, connections between the exciter and alternator shall be contained within the machine frame and connections carrying A.C. and D.C.

shall be segregated from each other. The terminal box shall be of sufficient size to conveniently terminate the size and number of the Owner's cables, which shall be intimated during detailed engineering. Suitable tinned copper pads shall be provided for power cable termination along with all necessary hardware and cable lugs. Glands and lugs shall be provided for control cables also. For single phase cables, gland plate shall be of non-magnetic material. Gland plate shall be removable type.

5.7 The generator shall be complete with voltage transformers necessary for AVR reverse power protection. The VT turn ratio shall be 440/110 V.

5.8 The generating set shall be so designed that it is capable of reaching its full voltage and frequency and shall be ready to take full load within 30 seconds of a remote starting impulse being received. It shall also be capable of starting minimum of 130 KW motor with other loads connected for which the voltage DIP during starting of motor shall not exceed 15%.

5.9 Suitable space heaters shall be provided for alternators. These space heaters shall be switched on automatically when DG set is not running.

6.0 DIESEL GENERATOR CONTROL PANEL:

6.1 General:

a. The control panel shall be sheet steel enclosed and shall be dust, weather and vermin proof providing a degree of protection of IP-52. Sheet steel used shall be cold rolled and at leas 2.0mm thick and properly braced and stiffened.

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

c. 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.

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

e. 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.

f. Two number of earthing terminals shall be provided.

g. All sheet steel work shall be degreased, 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 (gray) and painted with epoxy.

6.2 Control of Diesel Generating Sets:

a. All DG Sets shall be controlled independently.

b. Diesel Generator shall be capable of being stopped manually from remote as well as local. However, interlock shall be provided in the DG local control panel to prevent shutting down operations as long as circuit breaker is closed.

c. **Auto Operation:**

When mains power is available, the healthiness of this power will be monitored through a mains voltage monitor. If voltage on the 3 phases are within limits, the monitor will send a closing signal to the mains breaker and mains power will be connected to the load.

If the voltage drops on any phase or on all phases, the monitor will sense this drop through a timer, and if this drop persists for more than a pre-adjusted period of time (say 1 to 20 seconds) a signal is sent to the engine starting circuit while at the same time opening the mains supply breaker and disconnecting load from mains as voltage is below acceptable limits.

The engine starting control monitor will send a signal to the D.C. battery supply for starting the engine through the starting solenoid. When the engine is healthy, it starts up in a few seconds and the generator develops voltage. The generator voltage monitor, monitors the voltage and when the voltage is developed, this give a signal to the generator breaker which closes and connects the diesel generator to the load. Simultaneously, it sends a signal to de-energize the engine starting circuit and the starter motor is disengaged. The engine protection circuits for high water temperature and low lubricating oil pressure are also energized.

d. **Resumption of Supply:**

If voltage from mains is resumed, the main voltage monitor will sense this voltage for healthiness, i.e. for maintained correct voltage for a period of time (adjustable upto three minutes) and then send a signal to stop the engine and to change over the breakers from generator to mains and normal supply is resumed to the load. The solenoid operation and closing and tripping of breakers should be done through control voltage 24 V.D.C.

e. **Failure to Start:**

A three attempt starting facility using two impulse timers and a summation timer for engine shall be provided and if voltage fails to develop within 30 seconds from receiving the first start impulse, the set shall lockout automatically and a visual and audible alarm shall be given in the control panel. The remote panel shall receive “DG Trouble Alarm”.

6.3 The control panel shall have the following provisions for the control of each DG Set(Logic Control):

1. Master engine control which for OFF/AUTO/MANUAL/TEST with a facility for starting and stopping of the set.
2. Voltmeter 144 Sqmm with selector switches for alternator/Mains/Phases complete with protection.
3. Fine adjustment of speed.
4. Adjustment of output voltage.

5. Facility to transfer the speed and voltage control to the remote panel of customer including motorized potantio meters etc. as required.
6. Local/Remote selector switch to facilitate remote starting/stopping of the DG Set.
7. Frequency meter 144 Sqmm reed type.
8. Current transformers required for metering.
9. Ammeter 144 Sqmm with C.T. & selector switch.
10. Mains Supply, voltage monitor.
11. Engine control monitor.
12. Alternator voltage monitor.
13. D.C. Control relays, timers.
14. Engine protection system for low oil lubricating pressure and high water temperature.
15. Window type annunciator with static relays, alarm/hooter and accept, test, rest push buttons for all functions.
16. Engine hours run counter.
17. Field failure relay.
18. Control fuses.
19. Lifting Hooks.
20. Gland Plates.
21. Power/Control Contactors.
22. Earthing Studs.
23. Antivibration pads.
24. IDMT relays
25. Under Voltage Relays
26. Over Voltage Relays

6.4 Indication/Annunciation:

Pilot indicating lamps/shall be provided for the following:

1. Charger - ON/OFF
2. Earth Fault
3. Set shutdown due to `Engine overheating'
4. Set shutdown due to `Low oil pressure'
5. Set shut down due to `Lock of fuel'
6. `Low level of oil' in fuel service tank
7. Over speed trip
8. Alternator fault
9. High lube oil temperature
10. AVR fault
11. High inlet water temperature
12. Cooler bank trouble

Indicating lamp shall be of the panel mounting filament type with series resistors.

6.5 The DG Sets would normally be controlled from remote for which following provision are being made on the remote control panel. The necessary control devices/contacts for these external connections shall be wired out to the DG control panel terminal blocks.

1. Starting and stopping of the DG Set
2. Speed control of DG Set

3. Voltage control of DG Set
4. DG running indication
5. Watt hour meter, Wattmeter, Voltmeter, Ammeter and Frequency meter.

7.0 ENGINE SAFEGUARDS:

Safeguards shall be provided and arranged when necessary to stop the engine automatically by the following:

a. Energising a solenoid coupled to the stop lever on the fuel injection pump rack.
b. De-energising the "fuel on" solenoid
c. Energising the "fuel - cut off" solenoid.

The operation of the safeguard shall at the same time give individual warning of the failure by illuminating an appropriate local visual indicator and remote alarm at generator panel.

The contactors, relays and other devices necessary for signal and control, for above purposes shall be provided at Generator panel.

At the set at a easily accessible place an "EMERGENCY STOP" mushroom head stay put type P.B shall provided to stop the set in emergency mode.

The safe guard to "STOP THE SET" shall stop the set irrespective of mode selection of the set viz Auto, Manual or test for following cases, with simultaneous isolation of alternator ckt.

a. Emergency stop P.B's operation
b. Over speed.
c. Low lube oil pressure.
d. Earth fault or restricted earth fault or differential faults of Alternator.

8.0 SPARE PARTS:

8.1 Mandatory Spare Parts:

The list of mandatory spares which are considered essential by the Owner is indicated below. The contractor shall include all the mandatory spares in the proposal and indicate in the relevant schedule the item wise and total price for these spares mentioned. The quoted price of mandatory spares shall be used for bid evaluation purpose.

8.1.1 Diesel Engine:

a. Lube Oil filter Elements - 48 Nos.
b. By pass Filter Elements - 24 Nos.
c. Fuel Filter Elements - 24 Nos.
d. Air Cleaner - 2 Nos.
e. Gaskets (complete replacement for one engine) - 1 Set
f. Screen Filter Fuel Pump - 2 Sets
g. Element Corr. Resistor - 24 Nos.
h. Plate Corr. Resistor - 12 Nos.

8.1.2 Alternator, Exciter, Protection & Control Panels:

a. Current Transformer	- 1 No. of each type and rating
b. Rectifiers	- 1 Set
c. Diode	- 6 Nos.
d. Diode Fuses	- 6 Nos.
e. Relays	- 1 No. of each type
f. Control Switches	- 1 No. of each type
g. i. Contactors	- 1 No. of each type and rating
ii. Aux. Contactor	- 3 Nos. of each type and rating.
h. Cards for automatic voltage regulator (set consist of one number of each type of cards)	- 1 Set
i. Indicating lamp assly complete (with lens and holder) with resister	- 3 Nos.
j. Indicating Lamps	- 15 Nos.
k. Coil for Contactors	- 3 Nos. of each type
l. Timer	- 3 Nos. of each type
m. Control Fuses	- 50 Nos. of installed
n. Selector switch	- 3 Nos. of each type

Note: Set means complete replacement for one DG set.

8.2 Optional Spares:

In addition to the mandatory spares, Contractor shall indicate the recommend optional spares with unit and total prices for 3 years of normal operation of the equipment. The owner reserves the right to buy any or all recommended spares.

Prices of recommended spares will not be used for the evaluation of bids. The price of these spares shall remain valid up to 6 months after placement of the order for the main equipment. However, the contractor shall be liable to provide necessary justification for the quoted prices for these spares as desired by Owner.

9.0 TESTS:

9.1 The alternator of each type and rating shall be type tested for the following tests as per IS:4722, IEEE 115 & BS:5000.

a. Measurement of resistance, and air gap, XD, XD' and Xo.
b. Phase sequence test
c. Regulation test (for alternator only)
d. Measurement of leakage reactance and potier reactance (for alternator only).
e. Measurement of open circuit and short circuit characteristics.
f. Efficiency test
g. Temperature rise test
h. Momentary overload test

i. Over speed test
j. High voltage test
k. Insulation resistance test (both before and after high voltage test).
l. Measurement of polarization index (only for machines of 3.3 KV and above).
m. Noise level and vibration
n. Determination of deviation of voltage wave form from sinusoidal.

The charges of each type test shall be furnished separately. This shall be considered for evaluation of the bids. However, the owner reserves the right to waive any of the type test in which case the test charges quoted will be taken for adjustment purpose. Owner reserves the right to witness any or all the type tests.

9.2 The alternators and the starting motors shall be tested for the following routine tests as per IS:4722.

a. Measurement of open circuit and short circuit characteristics.
b. High voltage test.
c. Verification of degree of protection.
d. Regulation test
e. Phase sequence test
f. Vibration measurement
g. Insulation resistance test (before and after the high voltage test).

9.3 The control panels shall be tested/checked for following (but not limited to):

a. Compliance to drawing, data sheet and this specification.
b. Check for workmanship, wiring, conformity to functional requirements.
c. Calibration of instruments, meters C.T., P.T. etc.
d. H.V. test.
e. I.R. test before and after HV test.

9.4 The acceptance and routine tests of battery shall be done as per relevant standard.

a. Routine Test: All engines shall be subjected to routine test as per IS:10000.

9.5 Battery Charger (as per IS:4540/IEC 146):

a. All tests as per clause 9.03
b. Test for ripple factor & regulation
c. Heat run test (as type test)
d. Operational and functional tests.

10.0 ERECTION, TESTING, COMMISSIONING AND PERFORMANCE & GUARAANTEE TESTS/PROCEDURE AT SITE:

The entire work of erection, testing and commissioning of equipment supplied under this package shall be carried out by contractor and performance and guarantee tests to be conducted at site are also included under the scope of this specification. For this purpose the contractor shall depute suitable qualified technical supervisor to site on advance intimation to the Owner along with all special testing equipment required for testing and performance and guarantee tests. The

supervisor(s) shall be responsible for the installation, testing, commissioning checks and performance & guarantee tests mentioned in relevant clauses of this volume and the checks recommend by the contractor.

The successful contractor shall submit sufficiently in advance the bio-data of the supervisor giving details of his experience for Owner's approval.

The contractor shall ensure that the equipment supplied by him are installed in a neat workman like manner such that they are levelled, properly aligned and well oriented. The tolerances shall be established in Contractors drawings and/or as stipulated by the Owner.

All special tools and tackles and spares required for erection, testing and commissioning of equipment shall be supplied by the contractor. The bid shall include a list of these special tools, tackles and spares along with their item wise prices. The total cost for these tools, tackles and spares shall be included in the bid price.

Erection, testing and commissioning manuals and procedures shall be supplied, prior to dispatch of the equipment.

The contractor shall ensure that the drawings, instruction and recommendations are correctly followed while handling, setting, testing and commissioning the equipment.

10.1 Commissioning Check Tests/Performance and Guarantee Test:

In addition to the checks and test recommended by the manufacturer, the contractor shall supervise the following acceptance tests to be carried out on each test

i. Load Test:

The engine shall be given test run for a period of at least 6 hours depending upon the actual power factor of the load and set shall be subjected to the maximum achievable load without exceeding the engine or alternator capacity.

This full load test is to be followed immediately by a 10% overload run for one hour. The performance of the engine, alternator and exciter shall be satisfactory at the end of this overload run.

At the end of the full-load run, and again at the end of the over-load run, tests for temperature rise and insulation resistance of the alternator as specified shall be taken.

During the load test half hourly records of the following shall be taken:

a. Ambient temperature
b. Exhaust temp. when exhaust thermometer is fitted.
c. Cooling water temp. at a convenient point adjacent to the water output from the engine jacket.
d. Lubricating oil temperature when an oil cooler is fitted.
e. Lubricating oil pressure.
f. Speed
g. Voltage, wattage and current output.
h. Oil tank level

i. Colour of exhaust gas
j. Stored diesel oil temperature

ii. Insulation Resistance Test for Alternator:

Insulation resistance in mega-ohms between the coils and the frame of the alternator when tested with a 500 Volts megger shall not be less than

IR = 2 x (rated voltage in KV) + 1

iii. Temperature Rise Test for Alternator:

The temperature rise test of the alternator shall be carried out at the end of overload run of the DG Set. The procedure for temperature rise test shall be as follows:

"Just after overload test, the set shall be taken off for measurement of hot resistance of the alternator winding (stator and rotor) by using a suitable ductor. The cold resistance should also be measured before start of the DG Set. The temperature rise shall be computed by extra pollution method".

iv. Regulation Test:

The automatic and manual regulation of the alternator load at half and full rated load shall be tested for a nominal volts of 240 Volts, between phase to neutral and at 0.8 p.f. to verify the requirements of voltage and frequency variation as per IS:4722.

v. Speed and Governing:
The speed of the engine shall be verified to ensure that it conforms to the requirement of BS:5514.

vi. Vibration:

The vibrations shall be measured during full load test as well as during the overload test and the limit shall be 100 microns.

vii. Check of Fuel Consumption:

A check of the fuel consumption shall be made through out the test run of full load and overload.

viii. Insulation Resistance of Wiring:

On completion of the engine tests, the insulation of each unit of local wiring in the control cubicles and other components of the engine set, shall be tested with a 500 V insulation tester. The insulation resistance shall not be less than one mega-ohm between wires in a cable and engine set frame of cable sheath.

ix. Functional Tests:
a. Protective equipment on the engine against excessive cylinder temperature and low lubrication oil pressure.
b. Type of starting providing for the engine.

c. Pilot and fault indication lamps.

x. Noise Level:

The equivalent `A' weighted sound level measured at a distance of 1 meter horizontally from the base of any equipment furnished and installed under these specifications expressed in decibels to a reference of 0.0002 microbar, shall not exceed 93 DB.

L) TELEPHONE WIRING SYSTEM:

1.0 SCOPE:

1.1 This section relates to specification for the supply, installation, testing & commissioning of works included in electrical section for telephone system.

The scope of work included in this section is as follows :

a) Supply and installation of cables/wires G.I. fabricated perforated cable trays for laying telephone from the telephone exchange room up to each floor. (Cable tray quantity covered in cabling works).

b) Providing & installing cable ladders in the telephone vertical duct from Ground floor up to 2nd floor in each block of the building (Quantity covered in cabling works).

c) Providing & installing PVC conduits run from corridor to each office unit /Guest room to connect between cable tray & the telephone tag block.

d) Providing conduits for telephone wiring in the public areas with G.I. fish wire.

e) Providing & installing G.I./PVC moulded boxes including plug-in type telephone outlets in public/Guest office areas.

f) Providing & installing pipe sleeves for P&T incoming lines into the EPABX room if required.

The electrical contractor shall co-ordinate with P & T and other agencies to finalize the exact requirement.

2.0 CONDUITING :

2.1 All concealed /surface installation including the conduit run above the false ceiling space shall be heavy gauge black enamelled PVC conduit. The specification for materials & installation shall be same as described in electrical section. All relevant clauses are applicable for telephone system as well. The conduit for telephone system shall be installed minimum 20 cm away from the power conduit. Care shall be taken so that no telephone conduit is run in parallel to Electrical conduit in close proximity. Wherever telephone conduits cross power conduits, they shall be at right angle, to each other. All telephone conduits shall be earthed.

Size of Cable	**Conduit Size**
Up to 5 pair	20 mm
Above 5 pair up to 10 pair	25 mm
Above 10 pair up to 20 pair	32 mm

2 Nos. 2 pair	20 mm
3 to 5 Nos. 2 pair	25 mm
6 to 10 Nos. 2 pair cable	32 mm

The size of conduit shall depend upon no. of wires to be drawn. However minimum size of conduits shall be 19/20 mm.

2.2 All telephone wires shall be 0.61 mm dia annealed tinned copper conductor PVC insulated and PVC sheathed cables. All telephone cables inside the building shall be un-armoured Each out let shall be wired with 2 pair cables from final tag unless otherwise specified separately. From main tag block to sub tag block cabling shall be done with suitable size of telephone un-armoured cable laid in conduit/pipe/ cable trays.

3.0 CABLE TRAYS:

The specification & installation method described in the other section of electrical specification shall be applicable.

4.0 BOXES & TELEPHONE OUTLETS:

All concealed boxes shall be of G.I. as described in the electrical wiring section & shall match with electrical wiring accessories. The boxes/main Junction box shall be suitable for wall mounting having opening for cable/ conduit entry. All PVC cable shall enter the telephone junction box from the bottom through brass cable glands and enough cable length shall be available for termination. Each PVC cable serving the telephone socket shall be marked for identification.

Junction boxes shall be fully enclosed, kept tight with lockable hinged doors.

Prior to the system installation the contractor shall consult telephone department for their requirements and notify the Construction manager/Consultants on the same. All equipment like tag blocks, wires shall be MTNL approved makes.

5.0 SUPPLY OF MATERIALS:

Exclusions:

a) Telephone Exchange & Telephone instruments.

b) Main incoming cable.

Rest all material for distribution of telephone system as covered in BOQ shall be in the Contractors scope.

The telephone outlet shall be plug-in (clip on) type socket outlet. The switch plate shall be similar to the electrical wiring devices.

M) CABLING FOR TV SYSTEM:

1.0 The Co-axial shall be of wide band type with operation capability up to 500 MHz.

2.0 The ageing resistance of the co-axial cable shall comply with DIN 47252. Part 2, i.e. max. 5% increase in attenuation at 200 MHz measured by artificial ageing (14 days at 80 deg.C).

3.0 Cables shall meet or exceed the following specifications.

		RG-6 CA TV Type	**RG-11 CA TV Type**
a.	Centre Conductor	18 AWG copper coated steel 18% conductivity	12 AWG copper coated steel 18% conductivity.
b.	Dielectric	Foam polyethylene Nom. Dia. 0.180	Foam polyethylene Nom. Dia. 0.280
c.	Shield	Foil – 0.003 Al. Tape Braid – 34 AWG 4 end Al. 60% coverage dia. 0.212	Foil – 0.003 Al. Tape Braid – 34 AWG 6 end Al. 60% coverage dia. 0.314
d.	Jacket	Black PVC flame retardant dia. Over jacket 0.272 ± 0.008 Min. spot 0.023	Black PVC flame retardant dia. Over jacket 0.405 ± 0.010 Min spot 0.032.
	Electrical Properties		
a.	Dielectric Strength	Conductor to shield 2000 VDC	Conductor to shield 1500 VDC
b.	Capacitance	16.2 PF/Ft. Nom.	16.2 PF/Ft. Nom.
c.	Impedance	75.0 ± 3.0 ohms	75.0 ± 3.0 ohms
d.	Attnuation	DB/100 ft. 0.65 DB at 5 MHz 0.76 DB at 10MHz 0.96 DB at 20 MHz 1.98 DB at 100 MHz 4.21 DB at 450 MHz 4.80 Db at 550 MHz 6.49 DB at 1000 MHz	DB/100 ft. 0.35 DB at 5 MHz 0.94 DB at 50MHz 1.28 DB at 100 MHz 1.78 DB at 200 MHz 2.20 DB at 300 MHz 2.75 Db at 450 MHz 4.30 DB at 1000 MHz
e.	Velocity of Propagation	82.0% Nom	92.0% Nom
f.	DCR	35.47 ohms/1000 ft.	14.29 ohms/1000 ft.
g.	SRL	30 DB (10 MHz to 300 MHz)	20 DB (5 to 450 MHz)

4.0 Directional Couplers

4.1 These shall be of Ultra Wideband type and of hybrid circuit design.

4.2 These shall have a near flat frequency response over the entire operating range.

4.3 These shall have an aluminium cast housing for high frequency radiation resistance.

4.4 These shall have 'F' sockets for all input, output and branch ports.

4.5 The Tap offs shall be available in one way, two way and four way configurations.

4.6 The splitters shall be available in two way, three way and four way configurations.

4.7 The Tap offs shall be available in different tap values ranging from 11 dB, 15 dB, 20 dB, 25 dB and 30 dB.

4.8 These shall meet or exceed the following specifications:

	Tap offs	**Splitters**
a) Tap Loss	11-30 dB	----
b) Through Loss	0.5-4 dB	4.0 – 8.0 dB
c) Isolation	>22 dB	> 22 dB
d) Screening Factor	> 50 dB	> 50 dB

N) EXTERNAL LIGHTING:

The specifications covers the supply, installation, testing and commissioning of the following items:

- Street/Boundary lighting poles complete with all accessories e.g. looping box, clamps and required hardware's etc.
- Street/boundary lighting fixtures complete with all accessories e.g lamps latest etc.
- Wiring of street light fixtures.
- Cable laying, earthing and inter connection
- Foundation of poles and erection.
- All the items should be tested and installed as per the latest Indian standards specifications and all the sundry items such as clamps, bolts, nuts, racks, support miscellaneous wiring etc., required to make the installation complete shall be taken care while quoting the major items.

c) Erection of light fixtures

Each light fixture shall be connected to the supply through fuse/MCB of a suitable rating mounted in the looping box. The fitting shall be fixed to the pole properly and securely.

d) Wiring of light fixtures

The wiring of lighting fixtures from terminal block by means of 2.5 Sq.mm PVC insulated single core copper conductor through a suitable rated MCB/fuse and neutral. Cost of single core connecting cable from junction box to lighting fixture and earth wire complete with connections are included in the quoted rate.

e) Cabling works

All cable installation work shall be done as per relevant clauses of section cable work.

f) Tests

Before handing over the installation, tests on all fittings and cables shall be carried out as per IS specification.

The tests shall include;

a) Meggar test

b) Continuity test

c) Polarity test and phase sequence test

O) LIST OF APPROVED MAKES:

S.No.	Description		Makes
	MCB	:	Legrand/Schneider Electric/Seimens
	Moulded Case Circuit Breaker	:	Siemen/Legrand/ Schneider Electric
	MCB Distribution Board	:	Legrand/Schneider Electric/Seimens
	1100V grade PVC A cables	:	Polycab / Skytone/ KEI
	Cable lugs for 1100V grade cables	:	Dowells
	Cable compression glands for 1100 volt grade cables	:	Peeco/Comet
	Cable Tray	:	Pilco/RICO Steel/Approved by Consultant
	GI pipes	:	Jindal - Hissar /Tata
	Current Transformers	:	Automatic Electric/Kappa
	Meters	:	Rishab / Automatic Electric/Secure
	Selector Switches	:	Kaycee/Salzer
	Indication lamps and push buttons	:	BCH/L&T/Seimens
	PVC Conduit	:	BEC/Poly Pack
	Switches, Socket Plugs, TV, Telephone etc.	:	Legrand-Arteor/Schneider-Zencelo/ Pladio
	Telephone Tag Blocks	:	Krone/ Pouyet
	Telephone wires	:	Semon/Amp/Belden/molex
	PVC Insulated Wire	:	Finolex/ Polycab/Bonton/Lapp
	Industrial Socket in polycarbonate enclosure	:	Clipsal
	Ceiling Rose	:	Anchor
	Light Fitting	:	Philips/Crompton Greaves/ Wipro or as per Architect
	Ceiling/Exhaust Fan	:	Orient/ Crompton Greaves
	MV Panel Boards	:	Enerlac/ E&E/ Adelac/SPC
	Smoke Detector	:	Notifier/ EST/Bosch
	Heat Detector	:	Notifier/ EST/Bosch
	Fire Alarm Panel/Manual Call	:	Notifier/ EST/Bosch

Point/Response Indicator/Sounder		
Wire (FRLS)	:	Finolex/Polycab/ Lapp/Bonton
PA Speakers/Hooter	:	Notifier/ EST/Bosch
Relays	:	Alsthom/L&T/GE/Siemens/ As approved
Indicating Instruments	:	L&T/MECO/Rishabh
Transformer	:	Volt-Amp/Crompton/Uttam
Diesel Engine	:	Cummins/Caterpillar/Parkins
Alternators	:	Stamford/Marathon/Leroy Somer/ Jyoti/ Kirloskar/ Deudes
Anti Vibration Mountings	:	Dunlop
Battery	:	Chloride/Standard/Amco/Exide
Battery Charger	:	Waves Electronics/AE/Chhabi Electric
ACB	:	Legrand/Siemens/L&T /Schneider Electric
Contactors & Starters	:	Siemens/L&T /Schneider Electric/ S+S
Push Buttons	:	L&T/BCH/Siemens
Relays	:	Alstom/L&T/ S+S/ Neptune
Timers& Indicating Lamps	:	L&T/BCH
MS Conduit	:	BEC/STEELCRAFT
RG-6/Rg-11 (Co-axial Cable)	:	Comscope – USA
Music Speaker	:	EV/Onkyo/JBL/Bosch
Expansion bellow	:	Resistoflex
UPS	:	Eaton/Powerware/Libert

	BILL OF QUANTITIES				
1.0	The Bill of Quantities should be read with all the other sections of this Tender. All the items of work mentioned in the Bill of quantities covered by this contract shall be carried out as per the drawings, specifications and directions of the Owners and shall include the cost of all labour, materials, tools and plants, materials, testing if any with sub-Contractor's testing appliance, all octroi, royalties, taxes and Contractor's profit and overheads etc.				
2.0	The Tenderer shall be deemed to have studied the drawings, specifications and details of work to be done within the time schedule and to have acquainted himself of the conditions prevailing at site. The Quoted Rates shall be applicable for all works in any section/size/shape and Design etc.				
3.0	In case where the specifications given in the Description of the item of work given in Bill of Quantities are found wanting, the General Specification for Electrical Works Part – I (Internal), 1994 (with amendments upto date) shall be followed: where not specified the latest edition of relevant IS. Specifications shall be applicable. In case of any ambiguity in interpretations the Owners decision shall be final and binding.				
4.0	The rate(s) shall include the cost of providing / executing all ancillary – jobs / activities e.g. necessary excavations of				
5.0	The rates quoted for items of work shall include working in all conditions at all heights/depths including in/under water,				
6.0	The Quantities in this schedule are provisional. The Contractor will be paid for the actual quantity of work executed at				
7.0	All the items of work given in this schedule of quantities shall be executed strictly in accordance with Indian Electricity Rules and requirements of the Electric Supply Authority and British Standards Read in conjunction with the relevant drawings, specifications and the appropriate Indian Standards.				
8.0	The contractor shall visit the site and shall satisfy himself as to conditions under which the wok is to be performed. No extra claim consequence of ignorance or on grounds of insufficient description will be allowed at a later date.				
9.0	No Alteration whatsoever is to be made to the text or quantities of this Bill of quantities unless alteration is authorised in writing by the Owner. Any such alterations, notes or additions shall, unless authorised in writing be disregarded when tender documents are considered.				
10.0	In the event of error occuring to the amount column of the Bill of quantities, as a result of wrong extension unit rate and quantity, the unit rate quoted by the Tenderer shall be regarded as firm and the extension shall be amended on the basis of the rates.				
11.0	All error in totaling in the amount column and in carrying forward totals shall be corrected by owner. Any error in				
12.0	All materials shall be an Approved make of materials from the tender document.				
13.0	Any approvals and load sanction required from local authorities shall become part of the contractual obligations of the Contractor and nothing extra shall be payable to him.				
I.	**ELECTRICAL TENDER**				
A	**SUB-STATION EQUIPMENT**				
	SUPPLY & INSTALLATION OF SUB-STATION EQUIPMENT				
	The rates under this section shall also include:				
1.0	Supporting rigid frame work.				
2.0	All fixing accessories such as foundation bolts, nuts and bolts etc as required.				
3.0	Touching up all damaged paint with approved paint shade.				

4.0	Rubber mats shall be provided in front and back of the HT switchgear as per IS-5424-1969.				
5.0	All protection relays shall be microprocessor based.				
6.0	Provision to provide interface with BMS (BACNET over IP/MODBUS includding all hardware) shall be provided by the supplier.				
S.No.	**Description**	**Unit**	**Qty**	**Rate**	**Amount**
A.	**SUB-STATION EQUIPMENT INSTALLATION**				
1.1	Electricity Board Metering Panel (11 KV)				
	Receiving,unloading, installation, testing and commissioning of cubicle type 11 KV metering panel. The metering panel shall be provided free of cost by SEB.	Set	1		-
1.8	Supply and fixing in position 1000 mm wide rubber mat of 11 KV grade as per electricity rules and as per IS 5424 upto latest amendment.	Meter	2		-
1.14	Supplying, unloading, installation, testing and commissioning at site of pole mounted 200 KVA, 11 KV/415V, 3 phase, 50 Hz, DYN-11 step down, Delta/Star, Oil cooled. Transformer with OFF LOAD tap changer with +5% and -15% tappings in step of 1.25% bi-directional roller, diagram, rating plate, winding temperature indicator, marshalling box, lifting lugs and weather proof HT cable box, LT cable box disconnecting chamber minimum 8mm thick non magnetic gland plate etc. including mounting pole and accessories complete as per specification and as per IS : 11171. (The transformer shall be subject to all test specified in specification and test certificates shall be produced).	Nos.	1		
1.15	**RMU**				
	Supply, installation, testing and commissioning of 11KV, 630Amp., 20Ka/3sec., Extensible outdoor type Manual Ring main Unit comprising with two nos isolator and one no. 12KV,630A VCB/SF6 with self powered over current and earth fault relay complete with all standard and required accessories.	No.	1		
	TOTAL CARRIED TO SUMMARY (A)				
B.	**HT CABLES & SUBSTATION EQUIPMENT EARTHING**				
1.0	Providing and fixing approved cable supports and grouting the same as required.				
2.0	Effecting proper connections at terminations.				

S.No.	Description	Unit	Qty	Rate	Amount
3.0	Ensuring that provision is left in buildings and trenches as the work proceeds, for incorporating of cable supports at a later date				
4.0	Providing all, fixing accessories such as clamping devices, nuts and bolts etc.				
5.0	Clamping to supports where laid in trenches.				
6.0	Providing proper supports for cable terminals as called for.				
7.0	Wherever cables cross walls provide proper sleeves at the time of civil work.				
I.	**HT CABLES & CONTROL CABLES**				
1.1	Supplying and laying following size 11 KV grade High quality TROPOTHEN-X (XLPE) aluminium conductor armoured cables(earthed type) laid over MS supports in existing trenches.				
1.1.1	3 C x 120 sq.mm 11 KV XLPE cable	RM	12		
1.2	Supplying and making cable end terminations for the following size of 11 KV grade, High quality TROPOTHEN-X (XLPE) aluminium conductor armoured cable including termination kit complete heat shrinkable sleeve etc.				
1.2.1	3 C x 120 sq.mm 11 KV XLPE cable (Indoor)	Nos	1		
1.2.2	3 C x 120 sq.mm 11 KV XLPE cable (Outdoor)	Nos	1		
1.3	Supplying, laying GI sleeves of following sizes:				
1.3.1	100 mm dia	RM	12		
1.4	Supplying and laying of following 1100 volts grade PVC insulated PVC sheathed copper conductor armoured control cables in existing trenches cables trays, clamped on wall with suitable saddles, fixing bolts, including testing and commissioning.				
1.4.1	4 Core 2.5 sq mm PVC insulated copper conductor armoured control cables	RM	30		
1.5	Cable end termination of the following PVC insulated PVC sheathed copper conductor armoured cables of 1100 volt grade including supplying and fixing of crimping lugs, Double compression glands, cable sockets etc				
1.5.1	4 Core 2.5 sq.mm Control cable	Nos.	2		
	TOTAL (I)				

S.No.	Description	Unit	Qty	Rate	Amount
II.	**SUBSTATION EQUIPMENT EARTHING**				
	The rates for earthing items include :				
1.0	All fixing accessories such as brass, saddles, brass screws, rawl plugs etc.				
2.0	Jointing by rivetting and brazing after tinning.				
3.0	Cutting chases, holes and making good the same wherever required.				
4.0	Effecting adequate and proper interconnections.				
5.0	Use of copper thimbles.				
6.0	Excavation of earth, refilling, watering and ramming and making good as approved in all kinds of soil.				
7.0	All earthing pits shall be interconnected.				
8.0	Earthing shall be as per IS-3043-1987				
II	**SUBSTATION EQUIPMENT EARTHING**				
1.1	Supplying and fixing of following bare copper tapes including all necessary fixing accessories and effecting connections.				
1.1.1	25 mm x 6 mm thick copper tape.	RM	12		
1.3	Providing earthing stations at locations as called for including providing and laying 600 x 600 x 3.15mm thick tinned copper electrode with 2 Nos 25 x 6 mm thick copper strip, from earth electrode to inspection chamber,50 mm dia medium class G I pipe CI / chequered plate funnel with 20 gauge G I wire mesh, masonry chamber 300x300 mm with concrete base, CI chequered plate manhole cover with frame and bitumastic paint and packing of mixture of charcoal and common salt around plate electrode complete with digging of pit upto permanent moisture level but not less than 3 metres and back filling with clay or black cotton soil as required.	Nos	2		
1.3a	Providing earthing stations at locations as called for including providing and laying 600 x 600 x 6 mm thick tinned copper electrode with 2 Nos 25 x 6 mm thick GI strip, from earth electrode to inspection chamber,50 mm dia medium class G I pipe CI / chequered plate funnel with 20 gauge G I wire mesh, masonry chamber 1000 x 500 mm with concrete base, CI chequered plate manhole cover with frame and bitumastic paint and packing of mixture of charcoal and common salt around plate electrode complete with digging of pit upto permanent moisture level but not less than 3 metres and back filling with clay or black cotton soil as required.	Nos	2		
	TOTAL (II)				
	TOTAL CARRIED TO SUMMARY (I + II-B)				

S.No.	Description	Unit	Qty	Rate	Amount
C.	**MAIN LT PANEL, SUB LT PANEL, MDBs, SDBs, BUS DUCTS, RISING MAINS, SURGE PROTECTION DEVICES & FINAL DISTRIBUTION BOARDS**				
	The rates for the distribution boards shall also include the following :				
1.0	Supporting rigid steel framework.				
2.0	Cubicle type, 14 gauge CRCA sheet steel enclosed.				
3.0	Complete with interconnections and distribution bus bars.				
4.0	Proper bonding to earth.				
5.0	Painting/lettering on Breakers and distribution boards, the location and pupose, SLD of each panel and DB details.				
6.0	Providing cable clamps / supports within distribution boards cable alley.				
7.0	Door interlocking for all outgoing feeders shall be provided.				
8.0	ACBs shall have LCD based display showing current, power factor, voltage etc.				
9.0	All ACB shall be Microprocessor based with ON/OFF/Trip lamps, 3 NO + 3NC Auxiliary contacts other than used in control circuit.				
10.0	TPN MCCBs/ACBs shall be provided with solid neutral link.				
11.0	ACBs shall be suitable for ICS = ICU = ICW for 1 Second.				
12.0	All MCCBs shall be ICS = ICU.				
13.0	All MCCB shall have rotory handle with pad locking arrangement.				
14.0	Minimum breaking capacity for MCBs shall be 10 KA.				
15.0	All indicating lamps shall be provided with 2 amps control MCBs.				
16.0	All outgoing terminals shall be provided in cable alley on proper insulated supports				
17.0	Degree of protection of distribution panel enclosure shall be as under:				
a	IP 52 for indoor panels.				
b	IP 54 for service area panels.				
c	IP 55 for outdoor panels.				
18.0	Bus bar rating shall be considered as 1.0 amps and 1.6 amps per Sq mm for aluminum and copper bus bars respectively.				
19.0	All hinged door shall be earthed through 2.5 sq mm tinned braided copper wire.				
20.0	The tripping characteristics of MCBs shall be as under:				
a	Type "C" - For motor protection				
b	Type "B" - For resistive, lighting and convenience power				

S.No.	Description	Unit	Qty	Rate	Amount
c	Type "D" - For UPS and discharge lamps				
21.0	Potential free contacts and power contactor shall be provided in main LT panel, sub LT panel and SDBs for BMS integration for monitoring data and all starters required potential free contact for monitoring and controlling.				
22.0	MCCBs above 250 Amps shall have microprocessor based releases and upto 250 Amps shall have thermal magnetic trip unit. Only thermal shall not be acceptable.				
23.0	Removable lifting hook shall be provided in all transportation section.				
24.0	Main LT panel construction shall be of form 4 segregation, MDBs and SDBs shall be of form 3b construction.				
25.0	CT class for LT Panels shall be 15VA, Class - I				
1.0	**MAIN LT PANEL**				
i.	**Incoming Breaker (For Transformers):**				
	One Nos. 400A 4P motorised type MCCB (35 KA) with microprocessor based O/L, S/C & E/F releases and each having following protection and metering:				
	Metering for Transformer:				
	One (1) Nos. (0-500V) 96 x 96 mm voltmeter with control MCB & selector switch.				
	One (1) Nos. (0 - 400A) 96 x 96 mm CT operated Ammeter with selector switch, CTs etc.				
	One (1) Set of Phase Indication Lamp with 2A SP MCB.				
	Protection for Transformer:				
	One (1) Nos. Master Trip lock out Relay(86).				
	One (1) Nos. Trip Circuit Supervision Relay				
	One (1) Nos. Under Voltage Relay(27).				
	One (1) Nos. Over Voltage Relay with Definite Time Delay. (59)				
	One (1) No. Restricted Earth fault Relay(64N).				
	One (1) No. Automatic Power Factor Correction Relay with 400/5 15 VA CL : 1 CT's				
	24 V DC shunt trip.				
ii.	**Incoming Breaker (For DG Sets):**				
	One Nos. 250A 4P motorised type MCCB (25 KA) with microprocessor based O/L, S/C & E/F releases and each having following protection and metering:				

S.No.	Description	Unit	Qty	Rate	Amount
	Metering for DG:				
	One (1) Nos. (0-500V) 96 x 96 mm voltmeter with control MCB & selector switch.				
	One (1) Nos. (0 - 250A) 96 x 96 mm CT operated Ammeter with selector switch, CTs etc.				
	One (1) Set of Phase Indication Lamp with 2A SP MCB.				
	Protection for DG :				
	One (1) Nos. Under Voltage Relay(27).				
	One (1) Nos. Over Voltage Relay with Definite Time Delay. (59)				
	One (1) Nos. Reverse Power Relay				
	24 V DC shunt trip.				
iii.	**Bus Bar:**				
	400A, TPN aluminium bus bar (35 KA) of with heat shrinkable colour coded sleeves.				
iv.	**Bus Coupler**				
	One (1) No. 250A 4P motorised type MCCB (25 KA) without Release and each provided with ON/OFF/TRIP indication lamps backed up with control MCBs.				
v	**Outgoings**				
	ON/OFF/Phase indication & digital dual energy meter with RS 485 port shall be provided on each outgoing except capacitor feeders.				
	Two No. 125A, TPN MCCB (25 KA) .				
	Twenty Nos. 63A, TPN MCCB (25 KA) .				
	Capacitor Section - 100KVARx 1 Nos.				
	Each section comprises of following items:				
	APFC relays 12 stage - 01 no., MPP-H cylindrical, 440V capacitors with suitable ratings of MCCB, contactors, push buttons, indicating Lights, auto/manual selector switch for each bank.				
	MPP-H type capacitor Bank for each section				
	25 KVAR 2 NOS.				
	10KVAR 4 NOS.				
	5KVAR 2 NOS.				
	Main LT Panel as described above	**Set**	**1**		

S.No.	Description	Unit	Qty	Rate	Amount
2.0	**FINAL DISTRIBUTION BOARDS & ISOLATORS**				
2.1	Supply, installation, tesing and commissioning of the following MCCB Isolator/MCB Isolator in powder coated, MS enclosure of minimum 1.6 mm thickness (IP 42) with all accessories as required.				
a.	63 Amps 4P MCCB isolator with 63 Amps 4P RCCB of 100mA sensitivity.	Nos.	**2**		
b.	400 Amps TPN MCCB isolator	Nos.	**1**		
3.0	**Guest Room DB**				
	Comprising of following:				
	Incoming:				
	One (1) No. 25 A DP MCB (10 KA)				
	One (1) No. 25 A DP RCCB of 100mA sensitivity				
	One (1) No. 25 A DP Contactor				
	Outgoing:				
	Eight Nos. 20/10A SP MCB (10 KA)				
	Busbar:				
	100A DP copper bus bar				
	Earthing:				
	Suitable for 8 Nos. outgoing.				
	Distribution board as described above	Nos.	**30**		
4.0	**LPDB-8WAY - TPN**				
	Comprising of following:				
	Incoming:				
	One (1) No. 63 A FP MCB (10 KA)				
	One (1) No. 63 A FP RCCB of 100mA sensitivity				
	Outgoing:				
	Twelve Nos. 10/20A SP MCB (10 KA)				
	Twelve Nos. 32A SP MCB (10 KA)				

S.No.	Description	Unit	Qty	Rate	Amount
	Busbar:				
	100A FP copper bus bar				
	Earthing:				
	Suitable for 24 Nos. outgoing.				
	Distribution board as described above	Nos.	**2**		
5.0	**LPDB-12WAY - TPN**				
	Comprising of following:				
	Incoming:				
	One (1) No. 63 A FP MCB (10 KA)				
	One (1) No. 63 A FP RCCB of 100mA sensitivity				
	Outgoing:				
	Eighteen Nos. 10/20A SP MCB (10 KA)				
	Eighteen Nos. 32A SP MCB (10 KA)				
	Busbar:				
	100A FP copper bus bar				
	Earthing:				
	Suitable for 36 Nos. outgoing.				
	Distribution board as described above	Nos.	**6**		
6.0	**Porch D.B.**				
	Comprising of following:				
	Incoming:				
	One (1) No. 63 A TPN MCB (10 KA)				
	One (1) No. 63 A 4P RCCB of 30mA sensitivity				
	One (1) No. 63 A 4P Contactor				
	One (1) No. 0 - 24 Hr astronomical switch				
	Outgoing:				
	Eighteen (18) Nos. 10/16A SP MCB (10 KA)				
	Busbar:				

S.No.	Description	Unit	Qty	Rate	Amount
	100A TPN copper bus bar				
	Neutral link:				
	Separate for each phase.				
	Earthing:				
	Suitable for 18 Nos. outgoing.				
	Distribution board as described above	Nos.	**1**		
7.0	**PDB - Kitchen**				
	Comprising of following:				
	Incoming:				
	One (1) No. 100 A TPN MCB (10 KA)				
	One (1) No. 100 A 4P RCCB of 100 mA sensitivity				
	Outgoing:				
	Twelve Nos. 20/32A SP MCB (10 KA)				
	Three Nos. 20/32A FP MCB (10 KA)				
	Busbar:				
	150A TPN copper bus bar				
	Neutral link:				
	Separate for each phase.				
	Earthing:				
	Suitable for 24 Nos. outgoing.				
	Distribution board as described above	Nos.	**6**		
8.0	**Aviation Light D.B.**				
	Comprising of following:				
	Incoming:				
	One (1) No. 20 A DP MCB (10 KA)				
	One (1) No. 20 A DP RCCB of 100mA sensitivity				
	One (1) No. 20 A DP Contactor				
	One (1) No. 0 - 24 Hr astronomical switch				
	Outgoing:				

S.No.	Description	Unit	Qty	Rate	Amount
	Four (4) Nos. 10/16A SP MCB (10 KA)				
	Busbar:				
	100A DP copper bus bar				
	Neutral link:				
	Separate for each phase.				
	Earthing:				
	Suitable for 4 Nos. outgoing.				
	Distribution board as described above	Nos.	**1**		
9.0	**SURGE PROTECTION DEVICES**				
a	SPD as per Schedule 1 (For Main LT Panel) Phase to phase and phase to earth as per specification.	Nos.	**1**		
	TOTAL CARRIED TO SUMMARY©				
D.	**LT CABLES & CABLE TRAYS**				
	The rate shall also include the following :				
1.0	Providing and fixing junction boxes with covers including painting where ever required.				
2.0	Providing all fixing accessories such as clamping devices nuts, bolts and screws.				
3.0	Wherever the cables are of aluminium and bus bars of copper bimetallic lugs shall be used.				
4.0	All cable shall be laid with one diameter gap.				
5.0	All cables shall be IS approved.				
6.0	Double compression glands				
7.0	FR paint one meter on both side of wall penetration and at termination as per specifications.				
8.0	Burried LT cables to be laid atleast 750 mm below ground.				
D.	**LT CABLES & CABLE TRAYS**				
1.0	Supply,laying, testing and commissioning of 1100 Volt grade XLPE insulated, PVC sheathed aluminium conductor armoured cables on cable trays, existing trenches, burried cables including the cost of providing identification tags,route markers etc. complete as per specification and as per site requirements.				

S.No.	Description	Unit	Qty	Rate	Amount
a	3.5 x 300 Sq.mm cable	RM	42		
b	3.5 x 120 Sq.mm cable	RM	22		
c	4 x 25 Sq.mm cable	RM	65		
d	4 x 16 Sq.mm cable	RM	18		
2.0	Supplying of all materials and making terminations of 1.1 KV grade aluminium multicore cables of the following sizes. The work includes cable glanding using brass plated double compression glands, sizing the core leads, removing insulation, fixing suitable crimping type Copper/Aluminiun lugs/ thimbles by using hydraulic crimping tools with correct size of the dies, shaping the leads and neatly connecting the same to the equipment terminals.				
a	3.5 x 300 Sq.mm cable	Nos.	2		
b	3.5 x 120 Sq.mm cable	Nos.	4		
c	4 x 25 Sq.mm cable	Nos.	12		
d	4 x 16 Sq.mm cable	Nos.	2		
3.0	Supply and fixing pregalvanized factory fabricated G.I. ladder type cable trays, with bends, supports like nuts, bolts, washers, fasteners and all accessories of the following sizes as per specification with 2 Nos. 25 x 6 mm GI strip.				
a	600 mm wide				
	Runners 20 x 50 x 20 x 2.5 mm				
	Rungs 20 x 30 x 20 x 2.5 mm 250 mm C/C				
	Suspenders 2 Nos. 32 x 32 x 5 mm GI angle 1800 mm C/C	RM	28		
4.0	Supplying and fixing cable trays of the following sizes (in one/two/ three tier fashion either on one side of the wall or on two sides of the wall) of GI perforated type including grouting supports/hangers required hardwares etc. as specified in the drawings.				
a	50mm x 150mm x 50mm x 2mm with 2 Nos. of 25 x 6m GI strip	RM	30		
	TOTAL CARRIED TO SUMMARY (D)				
E.	**EARTHING SYSTEM**				
	Rates shall also include the following :				
1.0	All fixing accessories such as saddles, screws rawl plugs etc.				
2.0	Jointing by rivetting and brazing after rivetting in case of copper				
	and welding / bolting in case of GI earthing.				

S.No.	Description	Unit	Qty	Rate	Amount
3.0	Cutting chases / holes and making good the same wherever required.				
4.0	Effecting adequate and proper interconnections.				
5.0	Use of copper thimbles.				
6.0	Earthing system shall comply to IS:3043-1987.				
7.0	All earthing pits shall be interconnected.				
8.0	All equipment motors, DB's, panels to be connected on both ends				
	(double earthing) with suitable strip / wires.				
9.0	Soil resistingly test shall be conducted of the area where earth pits are to be located.				
E.	**EARTHING SYSTEM**				
1.0	EARTHING STATION(FOR ELV):				
1.2	Supply & laying of 600 x 600 x 3.0 mm Copper plate with 2 Nos. 32 x 6 mm copper tape form earth electrode to inspection chamber, 20mm dia medium class GI pipe, CI funnel with 20 gauge GI wire mesh, masonry chamber 300 x 300 mm with concrete base, CI manhole cover having locking arrangement with frame painted with bitumastic paint and packing with mixtures of charcoal and common salt around plate electrode including digging of pit upto permanent moisture level but not less than 3 meter and back filling as required.	Nos.	2		
2.0	EARTHING STRIP/WIRES:				
2.1	G.I. Earthing Strip/Wire:				
	Supply & installation, testing and commissioning of following sizes of GI strip/wire clamped to walls, cable trays, cables, in recess (including cost of digging & backfilling) or on surface etc for equipment earthing complete as required including inter connection between length at joints, all fixing accessories saddles, clamps etc. and other fixing hardware material as required for proper installation.				
a	25 x 6 mm strip	RM	225		
b	8 SWG Wire	RM	500		
3.0	Copper Earthing Strip/Wires:				
	Supply & installation, testing and commissioning of following sizes of copper strip/wire clamped to walls, cable trays or on surface etc for equipment earthing complete as required including inter connection between length at joints, all fixing accessories, saddles, clamps and other fixing hardware material as required for proper installation.				
a	25 x 6 mm strip	RM	12		
	TOTAL CARRIED TO SUMMARY (E)				

S.No.	Description	Unit	Qty	Rate	Amount
F.	**LIGHTNING PROTECTION**				
	Rates shall also include the following :				
1.0	All fixing accessories such as brass saddles, brass screws rawl plugs etc.				
2.0	Jointing by rivetting and brazing after rivetting in case of copper and by welding / bolting in case of GI.				
3.0	Cutting chases, holes and making good the same wherever required.				
4.0	Effecting adequate and proper interconnections.				
5.0	Use of copper thimbles.				
6.0	Lightning protection system shall comply to IS 2309 - 1989.				
7.0	All earthing pits shall be interconnected.				
F	**LIGHTNING PROTECTION**				
1.0	**SUPPLY, INSTALLATION, TESTING AND COMISSIONING OF ESE LIGHTENING PROTECTION SYSTEM**				
a	Lightning Protection Airterminal				
	Early Streamer Emission (ESE) Lightning protection Airterminal - should be complies with NFC - 17-102 standards. The Airterminal should be capable to collect the ambient electric field and to should emit the upward streamer with the defined Gain in time. Model to be selected for class I coverage for 30 m of radius	Nos	1		
b	Mounting Mast (Pole)				
	Al/SS/GI pipe fabrication support structure providing with suitable base plate, should have provision for Guy wire clamping system, termination arrangement for the Down-Conductor	Nos	1		
c	Lightning Strike Counter				
	Lightning Flash counter working electro mechanically without any power supply. Equipment should count lightning strokes of 0.4KA to 150 KA.	Nos	1		
d	Down Conductor & Accessories				
	1 x 70 Sq mm copper cable	RM	25		
e	Maintenance-free earthing System				

S.No.	Description	Unit	Qty	Rate	Amount
	Maintenance free Earth enhancing Chemical compound type Helita TEREC earthing with copper bonded steel rod with minimum 3.0 mts long and suitable termination clmaps.	Nos	2		
	TOTAL CARRIED TO SUMMARY(F)				
H.	**INSTALLATION OF LIGHT FIXTURES**				
	The rates shall include all components that may be required to complete the installation in all respects such as :				
a.	Internal wiring between accessories.				
b.	Earthing of light fixtures.				
c.	Suitable length of GI down rod, hanger and connecting wires, etc required to complete the installation.				
d.	Clamps, GI bolts, nuts, brass screws, saddles, and other fixing accessories as required.				
e.	Testing of all fixtures & ceiling fans.				
H.	**INSTALLATION OF LIGHT FIXTURES**				
	Storing, installation, testing and commissioning of the following lighting fixtures including fixing arrangement and with all accessories as required for the following complete with necessary GI pipe required for hanging of lighting fixtures.				
	ALL AREAS				
a	Wall scone lamp Guest bedroom fixture as approved by ID/Lighting Consultant/Owner.	Nos.	42		
b	Reading lamp as approved by ID/Lighting Consultant/Owner.	Nos.	30		
c	Pin hole downlight as approved by ID/Lighting Consultant/Owner.	Nos.	330		
d	Recessed downlight fixture as approved by ID/Lighting Consultant/Owner.	Nos.	344		
e	Strip LED light as approved by ID/Lighting Consultant/Owner.	Set	60		
f	Fluorescent light fixture as approved by ID/Lighting Consultant/Owner.	Nos.	44		
g	Floor/ Table lamp as approved by ID/Lighting Consultant/Owner.	Nos.	30		

S.No.	Description	Unit	Qty	Rate	Amount
h	Concealed light fixture as approved by ID/Lighting Consultant/Owner.	Nos.	0		
i	Shaving mirror light fixture as approved by ID/Lighting Consultant/Owner.	Nos.	30		
	TOTAL CARRIED TO SUMMARY (H)				
I.	**INTERNAL WIRING**				
1.0	The internal wiring shall include the wiring of light/fan/outlets to the distribution board via switch to the point.				
2.0	All fixing accessories such as clips, brass screws etc.				
3.0	All the switch boxes, ceiling fan regulator boxes, outlet and junction boxes shall be covered with modular cover plate as per specifications.				
4.0	All necessary material to complete the wiring as specified.				
5.0	1100 volts grade FRLS PVC insulated copper conductor stranded flexible PVC insulated wire of green colour for earthing of outlet boxes, light fixtures, and socket outlets.				
6.0	Painting of junction boxes.				
7.0	Embedding conduits and fittings in walls/ceiling etc. during construction including cutting chases and making good the same as necessary in the case of concealed conduit work.				
8.0	Outlet boxes and junction box.				
9.0	Providing GI saddles of approved quality and make and grouting the same for any exposed conduit work.				
10.0	All socket outlets shall be shuttered type with earth terminal.				
11.0	The quoted rates for metal clad splash proof socket outlets shall include the cost of suitable plug top.				
12.0	Lighting and power circuits shall be kept separate.				
13.0	Junction boxes for fans shall be covered with 3 mm thick hylam sheet.				
14.0	The minimum conduit size shall be kept 20 mm.				
A	**INTERNAL WIRING**				
	PUBLIC & SERVICE AREA				
1.00	Wiring for light point/fan point/call bell point with1.5mm^2 PVC insulated, copper conductor cable in recessed PVC conduit as required with fixing of plate box, switch and earthing complete with all accessories as required (first point shall be used from 1.5 mm^2 660V grade PVC insulated copper wires & looping with 1.5mm^2).				

S.No.	Description	Unit	Qty	Rate	Amount
	Switch Controlled				
a	Primary Light Point	Point	15		
b	Secondary Light point(Looped)	Point	105		
2.00	Wiring for exhaust fan plug with 1.5mm^2 PVC insulated, copper conductor cable in recessed PVC conduit as required with fixing of plate box, switch and earthing complete with all accessories as required (first point shall be used from 2.5 mm^2 660V grade PVC insulated copper wires & looping with1.5mm^2).	Point	0		
3.00	Wiring for 6A light plug point with 1.5 mm^2 PVC insulated, copper conductor cable in surface/ recessed PVC conduit as required with fixing of plate, box, 6A switch socket and earthing complete with all accessories as required (first point shall be wired from 1.5 mm^2 660V grade PVC insulated copper wires & looping with 1.5mm^2).	Point	12		
4.00	Wiring for 20Amp single phase power outlet with 4.0 Sqmm PVC insulated copper conductor wires in recessed PVC conduit including supply and fixing of 3 pin 20 Amp. outlet with 20 amp. switch and plug top in polycarbonate encloser and confirming IP-66 and internal wiring in Polycarbonate box, earthing of 3rd pin with PVC insulated, green colour 4.0 Sqmm copper wire, complete with all accessoreies as required.	Set	4		
5.00	Wiring for 20Amp Three phase power outlet with 4.0 Sqmm PVC insulated copper conductor wires in recessed PVC conduit including supply and fixing of 6 pin 20 Amp. outlet with 20 amp. switch and plug top in polycarbonate encloser and confirming IP-66 and internal wiring in Polycarbonate box, earthing of 3rd pin with PVC insulated, green colour 4.0 Sqmm copper wire, complete with all accessoreies as required.	Set	2		
6.00	Wiring for 16 Amp power outlet with 4.0 Sqmm PVC insulated copper conductor wires in recessed/surface MS/PVC conduit including supply and fixing of 6 pin 16 amps shuttered switch socket with internal wiring in G.I. box, earthing of 3rd pin with PVC insulated, green colour 2.5 Sqmm copper wire, complete with all accessories as required. (Power Socket).				
a)	One 16A outlets in one circuits with switch sockets of approved make.	Nos.	16		

S.No.	Description	Unit	Qty	Rate	Amount
b)	Two 16A outlets in one circuits with switch sockets of approved make.	Set	8		
7.00	Wiring for 2 Way Switch with 1.5mm^2 PVC insulated, copper conductor cable in recessed PVC conduit as required with fixing of plate box, switch and earthing complete with all accessories as required (first point shall be used from 1.5 mm^2 660V grade PVC insulated copper wires & looping with 1.5mm^2).	Nos.	12		
8.00	Wiring for light point(MCB Control) with1.5 mm^2 PVC insulated in recessed PVC conduit as required, with all accessories as required (first point shall be used from 1.5 mm^2 660V grade PVC insulated copper wire and looping with1.5 mm^2)- For Public area, Service area, and Guest floor Corridor				
	MCB Controlled				
a	Primary Light Point	No.	14		
b	Secondary Light Point(Looped)	No.	98		
9.00	Wiring for Aviation light with 3 core 2.5 Sq.mm PVC insulated PVC sheathed copper conductor armoured cable from Aviation DB to Aviation light including 16 SWG bare copper wire for continuous earthing etc. as required.	RM	20		
B	**INTERNAL WIRING:**				
	GUEST ROOM				
1.00	Wiring for light point/fan point/call bell point with1.5mm^2 PVC insulated, copper conductor cable in recessed PVC conduit as required with fixing of plate box, switch and earthing complete with all accessories as required (first point shall be used from 1.5 mm^2 660V grade PVC insulated copper wires & looping with 1.5mm^2).				
	Switch control				
i	Primary Light Point	Point	180		
ii	Secondary Light Point	Point	240		
iii	Master Switch (Two Way - Two module)	Point	30		
2.02	Wiring for 13A universal light plug point with 1.5 mm^2 PVC insulated, copper conductor cable in surface/ recessed /PVC conduit as required with fixing of plate, box, 13A switch socket and earthing complete with all accessories as required (first point shall be wired from 1.5 mm^2 660V grade PVC insulated copper wires & looping with 1.5mm^2).				
	two to four nos. switch and socket in one circuit	Point	120		

S.No.	Description	Unit	Qty	Rate	Amount
2.03	Wiring for 6A light plug point with 1.5 mm^2 PVC insulated, copper conductor cable in surface/ recessed pvc conduit as required with fixing of plate, box, 6A switch socket and earthing complete with all accessories as required (first point shall be wired from 1.5 mm^2 660V grade PVC insulated copper wires & looping with 1.5mm^2).	Point	90		
2.04	Wiring for two nos. 6A light plug point with 1.5 mm^2 PVC insulated, copper conductor cable in surface/ recessed PVC conduit as required with fixing of plate, box, 6A switch socket and earthing complete with all accessories as required (first point shall be wired from 1.5 mm^2 660V grade PVC insulated copper wires & looping with 1.5mm^2).				
	TV point controlled by one no. one way sw. from bed side and two nos. socket on wall(behind TV)	Set	30		
2.05	Wiring for 20A electronic Key Tag 1.5 mm^2 glass insulated, copper conductor cable in surface/ recessed PVC conduit as required with fixing of plate, box, Key tag and earthing complete with all accessories as required.	Point	30		
2.06	Wiring with 1.5 mm^2 PVC insulated, copper conductor cable in surface/ recessed PVC conduit as required with fixing of plate, box, bell push sw. complete with all accessories as required.	Point	30		
	Note :- Call bell will be supplied by the owner				
2.08	Wiring for 16 Amp power outlet with 4.0 Sqmm PVC insulated copper conductor wires in recessed/surface PVC conduit including supply and fixing of 6 pin 16 amps shuttered switch socket with internal wiring in G.I. box, earthing of 3rd pin with PVC insulated, green colour 4.0 Sqmm copper wire, complete with all accessories as required. (Power Socket).				
a)	One 16A outlets in one circuits with switch sockets of approved make.	Nos.	30		
b)	Two 16A outlets in one circuits with switch sockets of approved make(two nos. socket with two nos. switch shall be count one).	Nos.	60		

S.No.	Description	Unit	Qty	Rate	Amount
2.09	Supplying, installation, testing and commissioning of wiring with all the required material for following sub-mains with PVC insulated copper conductor of suitable size 1100 volts grade wires including concealed or surface mounted 25/40mm diameter pvc conduit or raceway either in slabs, partitions or overhead trusses terminating the conductors in respective panels, DBs, switch boxes with suitable size earth wires and associated hardwares etc. (conduit/raceway cost is also included in this item).				
a)	3 x 4 Sq.mm flexible un-armoured copper cables	RM	750		
	TOTAL CARRIED TO SUMMARY (I)				**-**
J	**EXTERNAL, LANDSCAPE, FAÇADE & WATER FEATURE LIGHTING**				
	INSTALLATION OF LIGHTING FIXTURES				
	Rate for installation of fixtures shall also include the following:				
i	All component that may be required to make the installation complete in all respects.				
	a. Suitable length of connecting wires.				
	b. Connecting wires to the point through connection block.				
	c. Bonding to earth wires.				
ii	Drilling holes in supports wherever required.				
iii	Fixing clamps, GI bolts and nuts / brass screws, saddles, rawl bolts and other fixing accessories as required.				
iv	Painting with enamel paint of clamps and other fixing accessories.				
v	Suitable size junction boxes with connector block for loop in loop out where ever applicable.				
vi	Testing of all fixture and after installation.				
1.0	Receiving, installation, testing and commissioning of the following lighting fixtures :				
a	Recessed in ground uplight	Nos	10		
b	Surface mounted uplight	Nos	5		
c	Surface mounted downlight	Nos	5		

S.No.	Description	Unit	Qty	Rate	Amount
2.0	Providing, installation of 125 x 125 x 80 mm polycarbonate weather proof (IP-55) junction box and terminal block on suitable size of RCC/GI foundation or support including excavation and back filling, supplying and laying cables through GI pipes upto junction box, wiring with 3 x 2.5 sq.mm PVC insulated 1100 volts grade copper conductor PVC insulated cables(unarmoured) from junction box to lighting fixtures complete	Nos	10		
3.0	Supplying, laying, testing and commissioning of PVC insulated copper conductor 1100V grade unarmoured cable on surface / existing pipe including providing of clamps etc. complete as required				
a	3C x 1.5 Sq. mm.	RM	80		
4.0	Making end termination and jointing of following sizes PVC insulated copper conductor unarmoured cable including cost of crimping lugs, sockets, insulation tape, double compression glands etc.				
4.1	3C x 1.5 Sq. mm.	Nos	10		
	TOTAL CARRIED TO SUMMARY(J)				
K	**TELEPHONE, DATA & MATV SYSTEM**				
	Providing and installing of all conduiting for telephone, data & IPTV system including providing and fixing of the following:				
1.0	All necessary specials and fittings				
2.0	Fixing of cover plates for inspection, junction and outlet boxes.				
3.0	Supply and fixing of 2 mm thick outlet boxes and junction boxes.				
4.0	All fixing accessories such as clips, nails, screws etc.				
5.0	Providing and fixing approved saddles, hooks and grouting the same as required, in the case of all exposed conduit work.				
6.0	Embedding conduits and accesssories in wall, floors etc. during construction and / or cutting chases and making good as necessary in the case of all concealed conduit work.				
K	**TELEPHONE, DATA SYSTEM**				
1.0	Supply and installation of following heavy duty FR PVC conduits including cost of junction boxes, bends, elbows, sockets, tees and all accessories, laying in slab cutting chasis and making good or surface mounted including all fixing hardware.				

S.No.	Description	Unit	Qty	Rate	Amount
a	25 mm dia PVC conduit	RM	100		
b	20 mm dia PVC conduit	RM	650		
2.0	Supply and installation of plug - in type telephone socket outlet with G.I outlet box and cover plate complete as required in 1 module plate.				
a)	RJ - 11	Nos.	76		
3.0	Supply, installation, testing and commissioning of category 6 flush mounted information outlets wired according to T568B standard with a faceplate. The plastic shall be high impact, flame retardant & UL-rated thermoplastic with minimum insulation resistance of 500 M Ohm.				
a)	Single surface mounted box with I/O outlet	Nos.	38		
4.0	Supply, installation, testing and commissioning of category 6 utp cable for low voltage system	Mtrs.	1200		
	TOTAL CARRIED TO SUMMARY(K)				**-**
L	**MATV SYSTEM**				
	Providing and installing of all conduiting and cabling for TV including providing and fixing of the following:				
1.0	All necessary specials for fittings				
2.0	Approved cover plates for inspection, junction and outlet boxes.				
3.0	2 mm thick outlet boxes and junction boxes.				
4.0	All fixing accessories such as clips, nails, screws etc..				
5.0	Providing and fixing approved saddles, hooks and grounting the same as required, in the case of all exposed conduit works.				
6.0	Embedding conduits and accessories in wall, floors etc. During construction and / or cutting chases and making good as necessary in the case of all concealed conduit work.				
7.0	All necessary cable connectors.				
L	**MATV SYSTEM**				
1.0	Supply and installation of following 16 guage MS conduits / 2 mm thick heavy duty FR PVC conduits including cost of junction boxes, bends, elbows, sockets, tees and all accessories, laying in slab cutting chasis and making good or surface mounted including all fixing hardware.				

S.No.	Description	Unit	Qty	Rate	Amount
a	20 mm dia PVC conduit	RM	240		
b	25 mm dia PVC conduit	RM	70		
	(For RG-11 Co-axial cable)				
2.0	Fixing of following outlets with 2 mm thick GI box completewith cover plate, connector etc. including cutting, chases, fixing of GI boxes and making good.				
2.1	TV Signals outlet	Nos.	32		
3.0	Supply, erection, testing and commissioning of following tap off with boxes for MATV system.				
3.1	One way Tap off (T-1)	Nos.	4		
3.2	Two way Tap off (T-2)	Nos.	15		
3.3	Three way Tap off (T-3)	Nos.	6		
3.4	Four way Tap off (T-4)	Nos.	2		
5.0	Supply, laying, connecting and commissioning of RG-11 co-axial cable for MATV system complete with all acessories required to complete the installation and as per specification in existing conduit	RM	80		
6.0	Supply, laying, connecting and commissioning of RG-6 co-axial cable for MATV system complete with all acessories required to complete the installation and as per specification in existing conduit	RM	300		
	TOTAL CARRIED TO SUMMARY (L)				
M	**GI RACEWAYS & JUNCTION BOXES**				
1	**GI Raceway & Junction boxes**				
A	Supply and fixing of 1.6 mm thick factory fabricated steel sheet galvanized raceway with internal metalic partitions as per site requirements including 1.6 mm thick GI cover, knockout holes,fixing accessories, earthing with 8 SWG copper bare conductor complete as required including bends, access boxes and cross over as per specification and site requirement.				
i	150 mm wide x 60 mm deep raceway	RM	80		
ii	100 mm wide x 60 mm deep raceway	RM	115		

S.No.	Description	Unit	Qty	Rate	Amount
2	Providing and fixing 150 x 150 x 70 mm deep 1.6 mm thick GI sheet junction box including providing 1.6 mm thick stainless steel cover as per specification.	Nos.	6		
	TOTAL CARRIED TO SUMMARY (M)				
O	**DG SETS**				
1.0	**D.G. SET (150 KVA):**				
	Supply, erection, testing and commissioning of 3 phase 415 volts 50 cycle per second 150 KVA 1500 RPM Diesel Generator Sets. The engine shall include flywheel to suit flexible coupling with guard, air cleaner, blower fan, heat exchanger, fuel pump, variable speed electronic governor, fuel filter, lub oil filter and pump, battery charger, 24 volt batteries of compatible capacity and instrument panel comprising of switch with key, lub oil temperature gauge, lub oil pressure gauge, water temperature gauge, battery charging ammeter, safety control for low lub oil pressure and high cooling water temperature with tripping etc. The alternator shall be self excited, self regulated, brushless and continuously rated for 150 KVA at 0.8 P.F., 3 phase 415 volts 50 cycle 4 wire system and shall be provided with static excitation unit, Alternator insulation shall be class 'F' suitable to withstand tropical conditions and shall generally comply with B.S. 5000 and IS 4722 including 250A, 400V, 50Hz, FP ACB for outgoing.	Set	1		
2.0	**AMF Panel:**				
	Design, manufacture, supply, erection, testing & commissioning of AMF logic control panel with all accessories as per specification. (Suitable for 150 KVA D.G. Set.)	Set	1		
3.0	**Fuel Piping:**				
	Supply, laying, testing and commissioning of piping system in existing trench/along walls including cost of saddles, clamps, fasteners etc. complete as per specifications, as required and as below.				
	Class C MS piping as per IS 1239 of following sizes.				
	25mm NB	Mtr	25		
4.0	Supply, erection, testing and commissioning of semi rotary hand pumps.	No.	1		

S.No.	Description	Unit	Qty	Rate	Amount
5.0	Supply, installation, testing and commissioning of 1hp. Flame proof pump with canopy/encloser for lifting fuel from ground floor to roof top min 20m head including cable , conduites and sensor and starter panel with sounder for automatic operation.	No.	1		
	TOTAL CARRIED TO SUMMARY(O)				
P	**FIRE ALARM AND PA SYSTEM**				
	SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF THE FOLLOWING AS PER SPECIFICATION.				
	SECTION - I : FAS SYSTEM SHOULD BE UL LISTED/EN STANDARD				
	CONTROL PANEL :				
1.0	Supply of Microprocessor based Networkable Analogue Addressable FACP with 2 loops. Minimum 127 detectors per loop. LCD display, built-in RS-232 interfaces for programming via a PC and serial printer interface • 5 on board programmable Form C relays rated at 1 amp at 30VDC (Fire1, Fire2, trouble, supervisory, aux.) • 500mA of auxiliary power available rated at 24 VDC • 500 network wide software zones • Network Capability of up to 64 panels • Auto-learn feature • Fire Drill test function • Walk Test function • Alarm Verification feature Powerful & versatile Cause & Effect programming (up to 500 maximum, network wide) including: *Cause & Effect action, *Disable function configuration including printing system. *Test mode configuration				
2.0	Supply, installation, testing & commissioning of graphical illustration display software with PC Connectivity & **dotmatrix alarm printer** for Fire detection system				
	SUB TOTAL FOR CONTROL PANEL				
	DEVICES				
	Following analog addressable devices compatible with the control panel covered above				
3.0	Supply of Analogue Addressable **Multisensor Detector**, including base Simple and reliable device addressing method, Automatic compensation for sensor contamination, Two built-in power/alarm LED's, Programmable Non-polling LED's, Non-directional smoke chamber, Vandal resistant security locking feature complete as required.	Nos.	18		

S.No.	Description	Unit	Qty	Rate	Amount
4.0	Supply of Analogue Addressable **Multisensor Detector with in built sounder**, including base Simple and reliable device addressing method, Automatic compensation for sensor contamination, Two built-in power/alarm LED's, Programmable Non-polling LED's, Non-directional smoke chamber, Vandal resistant security locking feature, complete as required.	Nos.	30		
5.0	Supply of Analogue Addressable **CO Detector**, including base Simple and reliable device addressing method, Automatic compensation for sensor contamination, Two built-in power/alarm LED's, Programmable Non-polling LED's, Non-directional smoke chamber, Vandal resistant security locking feature, complete as required.	Nos.	2		
6.0	Supply, installation, testing and commissioning of **Control Relays** shall be complete with Pilot Relay for Tripping of Third Party Equipment, suitable for switching 5A/15A current through the Relay contacts , MS Powder coated Junction Box for mounting on Surface, Cable lugs at Ends, cable compression glands, cable tags and Ferruling as per technical specification & drawings. The CR will be connected to AHU for tripping, Electrical system for tripping, Elevator Management,music sysytem, fire suppression system in kitchen and gas bank for alarm	Nos.	2		
7.0	Supply, installation, testing and commissioning of **Control Module** shall be complete with Pilot Relay for control of Third Party Equipment, suitable for switching 5A/15A current through the Relay contacts , MS Powder coated Junction Box for mounting on Surface, Cable lugs at Ends, cable compression glands, cable tags and Ferruling as per technical specification & drawings. The CM will be connected to pressurisation fans, smoke exhaust fans etc.	Nos.	7		
8.0	Supply, Installation, Testing & Commissioning of Addressable **Monitor Module** with all mounting accessories, complete with MS Powder coated Junction Box for mounting on Surface, Cable lugs at Ends, cable compression glands, cable tags and Ferruling.	Nos.	4		
9.0	Supply, installation, testing & commissioning of **Addressable Manual Pull Station** with Address Switch and all mounting accessories , complete with MS Powder coated Junction Box for mounting on Surface, Cable lugs at Ends, cable compression glands, cable tags and Ferruling as per technical specification.	Nos.	5		

S.No.	Description	Unit	Qty	Rate	Amount
10.0	Supply, installation, testing & commissioning of **Hooters/Sounder with Light Strobe(min 100 Candela) including modules** with minimum 4 distinct sound patterns to indicate Exit doors and direct occupants for safe and fast evacuation , complete with MS Powder coated Junction Box for mounting on Surface, Cable lugs at Ends, cable compression glands, cable tags and Ferruling.as per technical specification.	Nos.	7		
11.0	Supply, installation, testing & commissioning of **Fault Isolator** as per technical specification.	Nos.	2		
12.0	Supply, installation, testing & commissioning of **LPG gas detector with panel & module with built in sounder** as per technical specification.	Nos.	4		
13.0	2 way communication Fire Fighter's Telephone Jack with module as per specifications complete as required.	Nos.	5		
14.0	2 way communication Fire Fighter's Handset	Nos.	2		
	SUB TOTAL FOR DEVICES				
	WIRING ACCESSORIES FOR FA SYSTEM				
	Supply Installation Testing of Wiring including junction box and end Terminations for the following				
15.0	2CX 1.5Sq.mm, shielded Copper conductor, Armoured cable FRLS grade PVC insulated flexible WIRE, 2HRS fire rated.	Mtrs.	915		
	SUB TOTAL FOR WIRING ACCESSORIES				
	TOTAL FOR SECTION I				
	SECTION - II				
	PA SYSTEM				
16.0	Supply, installation, testing and commissioning of rack mounted Booster Amplifier 2X60 W	Nos.	1		
17.0	Supply, installation, testing and commissioning of one of the approved make ceiling/wall mounted multi tap speakers of 3/6 W rated power handling capacity, in-built line matching transformer, wide opening angle, complete with all mounting accessories as per specifications.	Nos.	40		

S.No.	Description	Unit	Qty	Rate	Amount
18.0	Microcontroller Based 6 **Zone** Selector with Following features, (a) Feather type key pads to select the zones. (b) Moulded plastic attractive enclosure. (c)Backlight LED Display (d) User friendly interactive display. (e) Announcement selector - PTT Switch. (f) Listen selector switch. (g) All Call switch to select all zones simultaneously for announcement (h) Built in auto change over UI certified for over ride the music. (i) Pre recorded voice evacuation system. (j) Shall be ingrated with Fire Alarm system. Controller Unit with (a) Built-in Power supply. (b) Zone Selector Switching Circuit (c)Terminal blocks to terminate zones ,wires, amplifier wires etc., (d) Built-in Power Supply for TB Speaker (e) CALL Monitoring Circuit (f) Additional terminal blocks for CALL & Mic signal Gooseneck Microphone (Fitted in the Console) (Should be able to add 4 Additional Zones if required)	Nos.	1		
19.0	Supply, installation, testing and commissioning of rack mounted CD Player with USB & MP3	Nos.	1		
20.0	Supply, installation, testing and commissioning of 29 U Rack	Nos.	1		
21.0	Supply, installation, testing and commissioning of Podium Mic with on/off switch.	Nos.	1		
	SUB TOTAL FOR TWO WAY COMMUNICATION SYSTEM				
	WIRING				
	Supply Installation Testing of Wiring including end Terminations for the following				
22.0	2C x 1.5 sq mm Twin twisted, PVC sheathed, armoured copper Cable suitable for PA & Music system.	Mtrs.	430		
23.0	Multi core Mic cable , PVC sheathed, Un-armoured copper Cable.	Mtrs.	20		
	SUB TOTAL FOR WIRING				
	TOTAL FOR SECTION - II				
	TOTAL FOR SECTION - I + II (P)				

S.No.	Description	Unit	Qty	Rate	Amount
	SUMMARY				
S.NO.	**DESCRIPTION**				**AMOUNT**
I.	**SUMMARY**				
A	HT SUB-STN. EQUIPMENT	RS.			
B	HT CABLES AND SUB STN. EARTHING	RS.			
C	MAIN LT PANEL AND DISTRIBUTION BOARDS	RS.			
D	LT CABLES AND CABLE TRAYS	RS.			
E	EARTHING SYSTEM	RS.			
F	LIGHTNING PROTECTION SYSTEM	RS.			
H	INSTALLATION OF LIGHT FIXTURES	RS.			
I	INTERNAL WIRING	RS.			
J	EXTERNAL, LANDSCAPE,FAÇADE	RS.			
K	CONDUITING FOR TEL, DATA AND MATV	RS.			
L	MATV SYSTEM	RS.			
M	RACE WAYS AND JUNCTION BOXES	RS.			
O	DG SETS	Rs.			
P	FIRE ALARM AND PA SYSTEM	Rs.			
	TOTAL	**RS.**			