REPUBLIC OF KENYA
MINISTRY OF HEALTH

EAST AFRICA’S CENTERS OF EXCELLENCE FOR SKILLS AND TERTIARY EDUCATION IN BIOMEDICAL SCIENCES

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GENERAL ELECTRICAL INSTALLATIONS
(ALL RATES EXCLUSIVE OF TAXES)

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1 PART A: GENERAL ELECTRICAL SPECIFICATIONS

1.1 INTRODUCTION

This section specifies the general requirement for plant, equipment and materials forming part of the Contract Works and shall apply except where specifically stated elsewhere in the Specification or on Contract Drawings.

1.2 REGULATIONS

The Contract Works shall comply with the current editions of the following:

1) Electric Power Act and the Rules made there under
2) The Electricity Supply Authority Byelaws.
4) The United Kingdom Chartered Institute of Building Services Engineers (CIBSE) Guide ‘K’ on electricity in Buildings.
6) Kenya Bureau of Standards (KEBS) standard specifications and code of practise, or other equal and approved standard specifications and codes.
7) The Local Authority Byelaws
8) The Employers Safety Regulations.
9) General Electrical Specifications (GES 1 & 2)

1.3 QUALITY OF MATERIALS

The quality of materials required for completion of the electrical installation works shall be as detailed in this specification and contract drawings unless otherwise instructed. All materials shall be new and of best quality and approved origin.

1.4 TYPE OF INSTALLATION-WIRING SYSTEMS

Electrical installation shall be carried in either one of the following wiring systems:

System A – PVC Insulated and Sheathed Cables Clipped To the Surface Of The Walls And Roof Members Or To The Ceilings

The installation shall be carried out in an approved type twin or three core PVC insulated and sheathed cables, the conductors of which shall be of copper. Cables shall be securely fixed to the surface of the walls and in the roof spaces, or fixed to the underside of the ceilings when there is no reasonable access above the ceiling. Non-corrodible saddles or buckle clips and nails shall be used for fixing and at intervals not exceeding 225mm. Where cables pass through holes they shall be bushed. Wooden bits or plastic bits shall be used as plugs in walls for firmly fixing the saddles or buckle clips on walls or other surfaces.

Under no circumstances will joints of conductors be permitted in the run of a wiring cable. Cables shall be connected together only by looping into the terminals of switches, ceiling rose junction boxes or other accessories or by approved connectors installed in suitable junction boxes. Under no circumstances will taped joints be permitted.
In all cases the cable sheathing shall be carried into the switch, ceiling rose, junction box or other accessories.

Surface installed cables shall not be installed within 300mm of a metal roof, unless clipped to the lower side of wooden member of the roof or otherwise protected from radiant heat.

**System B - PVC Insulated And Sheathed Cables Clipped To Roof Members And Run In Metal Or Plastic Conduits Drops Concealed In Walls**

The wiring shall be carried out as system A except that cables shall be enclosed in either steel or plastic conduit where drops are required to switches, distribution board, socket outlets or other accessories.

**System C – Cables In Steel Screwed Conduit Or Trunking Fixed To The Surfaces Of Walls And Ceilings**

The wiring shall be carried out in an approved type of single core, plastic insulated cable enclosed in steel screwed conduit or trunking, mechanically and electrically continuous throughout.

Conduit and trunking shall be run on the surface of the walls and ceilings, or in false ceiling spaces. Conduit shall be secured in position by means of steel galvanized spacer bar saddles, and counter sunk brass screws. Conduit shall run horizontally on the walls or vertically to switches or outlets.

**System D – Cables Enclosed In Concealed Steel Screwed Conduit Or Trunking**

The wiring shall be carried out in approved type of single core, plastic insulated cable, enclosed in steel screwed conduit or trunking mechanically and electrically continuous throughout.

Conduit shall be buried in the wall and floors of the building and either run in roof space or buried in structural slabs.

**System E – PVC Insulated Cables With or Without Earth Continuity Conductor Enclosed In Concealed Non-Metallic Conduit or Trunking**

Wiring shall be carried out in an approved type single core, plastic insulated cable with copper conductor with or without earth continuity conductor enclosed in high impact, heavy gauge, non-metallic conduit or trunking of PVC material or equivalent.

Conduit shall be buried in the walls and floors of building, and either run in roof space or buried in structural slabs.

**System F – PVC Insulated Cable With or Without Earth Continuity Conductor Enclosed In Non-Metallic Conduit or Trunking Fixed To the Surfaces of Walls and Ceilings**

Wiring shall be carried out in an approved type single core plastic insulated cable with or without earth continuity conductor enclosed in high impact, heavy gauge, non-metallic conduit or trunking.
Conduit shall be installed in similar way as system C.

**System G - Mineral Insulated Copper Sheathed Cables**

The wiring shall be carried out in single core or multi-core mineral insulated copper sheathed cable run on the surfaces of walls and ceilings, in the roof space or concealed in walls and floors.

**System H – PVC Insulated Single Wired Armoured and PVC Sheathed (PVC/SWA/PVC), Cable Laid In Ducts, Trenches and Saddles to Walls**

Cables shall either be suspended on purpose made frame and hangers, saddled on walls and roof members, drawn through ducts or laid in trenches. Cables suspended on multiple hangers shall be so arranged that one cable can be removed without disturbing the others. Frames, and hangers shall be galvanized or of non-corrosive material and shall not be fixed in contact with other metals with which they are liable to set up electrolytic action. All spacing of cable hangers and support shall not exceed those laid down for the relevant size and type of cable in the current edition of the I.E.E. Regulations or Kenya Bureau of Standard wiring Regulations.

1.5 **PVC CONDUITS, TRUNKING AND ASSOCIATED FITTINGS**

For the purposes of these specifications, all non-metallic conduits shall be of high impact quality rigid PVC conforming to B.S 4607 or KS04-179: 1988 and IEE regulations and all conduit fittings and accessories shall be of the same quality.

Conduit outlet and switchboxes shall be able to receive an earthing terminal and shall have threaded brass inserts for cover fixings.

Solid elbows and tees shall not be permitted without the written approval of the Engineer. No conduit smaller than 20mm (nominal) diameters shall be allowed.

Trunking where required should be of high impact quality rigid PVC of an approved type.

1.6 **INSTALLATION OF PVC CONDUITS**

(i) **Conduit shall be installed** buried in plaster works and floor screed except when run on wooden or metal surface, when they will be installed surface supported with saddles every 600mm. Conduits shall be laid at a time during the building construction as may be approved by the Engineer.

(ii) **Conduits run in chase** shall be firmly held in position by means of mild steel pipe hooks to avoid displacement when plastering. It shall be at least 10mm below plaster level. In poured reinforced concrete floors and roof slabs, the conduit shall first be laid before the concrete is cast in situ. It shall be securely fixed in position to prevent displacement during the pouring process and shall be sealed against the ingress of water and cement during in mechanical vibration.

(iii) **The conduit system when installed** and before wiring, shall be kept plugged with well-fitting plugs and when short conduit pieces are used as plugs, they shall be doubled over and tied firmly together with steel wire. Only after the conduit system
has been completely cleansed of bungs, burrs and building debris, shall wiring be carried out.

(iv) **Conduits connection** shall either be by a demountable (screwed up) assembly or adhesive fixed and water tight by solution. The conduit and fittings must be clean and free of all grease before applying the adhesive. When connections are made between the conduit and switch boxes circular or non-screwed boxes, care shall be taken that no rough edges of conduit stick out into the boxes. The conduits shall be fixed to the outlet boxes either by gluing the plain end into the marbled spigot of the outlet box or by using a proprietary adaptor (half threaded couplers) and fixing it to thin walled outlet boxes by means of screwed bushes.

(v) **Conduits and trunking** shall be mechanically continuous and water tight from the point of entry into the building to the final conduit outlet boxes and such joints as are required in the conduit shall be made with plain conduit couplers glued in position. Care should be taken to ensure all joints are made watertight by using appropriate adhesive.

(vi) **Conduits shall be bent and formed** in strict conformity with the manufacturer’s instructions. Sizes up to 25mm diameter may be bent cold with the use of appropriate sized bending spring. Larger conduits are to be preheated before inserting the rubber cord to prevent kinking. Conduits badly formed or bent or damaged in any way shall not be used and in all cases the inner radius of the bend shall not be less than 2.5 times the diameter of the conduit. Runs between draw in boxes are not to have more than two right angle bends or their equivalent without the approval of the Engineer. The sub-contractor may be required to demonstrate to the Engineer that wiring in any particular run is easily withdrawable and sub-contractor may, at no extra cost to the contract; be required to install additional draw-in-boxes where required. If conduit installed in straight runs is in excess of 6000mm, expansion couplings as manufactured by Egaweld or equivalent shall be used at intervals of 6000mm.

(vii) **Draw-in-boxes** shall be kept to minimum and where they occur of necessity within the floor area, the Engineer shall approve the type in writing.

(viii) **Conduit fittings** of the inspection type shall be so located that they remain readily accessible upon final completion of the building.

(ix) **Where the conduit loop-in-system is employed**, back outlet boxes shall be used and conduits shall normally be laid in the floor screed on the upper side of the slab. Draw in wires shall not be permitted where the loop-in-system is employed and cables will need to be drawn into conduits with a draw-in-steel tape.

(x) **All spare ways in junction boxes** etc. left for possible future extension shall be fitted with stopping plugs. Where conduits runs are to be concealed in pillars and beams the approval of the Structural Engineer shall be obtained. The electrical contractor shall be responsible for determining the accurate position of all holes, chases etc. on site or if the Engineer so directs shall provide the building contractor with dimensional drawings to enable him to mark out and form all holes and chases. Should the electrical contractor fail to inform the building contractor of any inaccuracies in this respect they shall be rectified at the electrical contractor’s expense.

(xi) **It will be the contractor’s responsibility** to ascertain from site, the details of reinforced concrete or structural steelwork and check from the builder’s drawings and
positions of walls, structural concrete and finishes. No reinforced concrete or steelwork may be drilled without first obtaining the written permission of the Structural Engineer.

(xii) The drawings provided with these specifications indicated the appropriate position only of points and switches, but it shall be the electrical contractor’s responsibility to mark out and centre on site the accurate position of points and switches where necessary in consultation with the Architect and the Engineer.

(xiii) Where it is necessary to feed surface mounted equipment the concealed conduit shall first be terminated in a concealed conduit box.

1.7 PVC CONDUIT BOXES AND ACCESSORIES

(i) All conduit outlets and accessories of non-metallic material including couplers, ordinary clips, saddles, pipe hooks, reducers, stopping plugs, locknuts and male and female bushes shall be manufactured dimensionally to B.S. 31/1940 BS 4607 part 1, 1970 or to KS 04-179 1979 Part 1.

(ii) Solid tees shall not be used while solid inspection elbows or bends or inspection tees shall be used only in exceptional circumstances and then only with the Engineer’s approval. Small circular pattern boxes are to be used with conduits up to and including 25mm outside diameter. Rectangular pattern adaptable boxes are to be used for conduits of 32mm outside diameter and larger. For drawing in of cables in exposed runs of conduits, standard pattern through boxes shall be used.

(iii) Boxes shall be not less than 32mm deep and of such dimensions as will enable the largest appropriate number of cables for the conduit sizes to be drawn in without excessive bending.

(iv) Boxes will not be permitted in floors unless approved. Boxes cast-in situ must face downwards from the ceiling/ floor section.

(v) The circular boxes or equipment loop-in boxes shall be provided and securely fixed for all ceiling points. When the conduit is run on the surface, all circular boxes for ceiling points shall be fixed with screws.

(vi) Where ceiling boxes occur and the ceiling box is recessed below the finished level of the ceiling, suitable extension rings to accommodate the ceiling box must be provided.

(vii) Where ceiling boxes including extension rings are flush with the ceiling surface, break joint rings (biscuit rings) shall be provided to hide the joints.

(viii) In all the cases one ceiling box shall allowed per fitting except where fluorescent fittings are specified when two such boxes per fittings are desirable. When two such boxes per fitting are installed they shall be flush with ceiling and if necessary fitted with break joint rings or dome covers.

(ix) Where a non-metallic outlet box of thermoplastic material is used for the suspension of a lighting fitting care shall be taken to ensure that the temperature of the box does not exceed 60°C. The weight suspended from the box shall not exceed 3kg. Where it is intended to fix enclosed lighting fitting directly to a box or to suspend a fitting of weight in excess of 3kg, separate steel insert clips shall be used.
All boxes intended for switches, socket outlets, lighting fittings or other outlets shall be fitted with brass ferrules to accommodate the fixing of screws. Ends of lengths of conduit shall be reamed and where they terminate at boxes, trunking and accessories not fitted with sprout entries shall be bushed to prevent damage to cables.

All draw boxes and inspection boxes shall be covered with appropriate box covers with screws of non-corrosive type.

### 1.8 ADAPTABLE BOXES

Adaptable boxes shall be of PVC or mild steel (of not less than 12 SWG) and to be of black enamelled or steel galvanised finish according to location. They shall be square or oblong shape complete with lids secured by four 2BA brass rounded screws. No adaptable box shall be less than 75mm x 75mm x 50mm or larger than 300mm x 300mm x 75mm and shall be adequate in depth in relation to the size of conduit entering it. Conduits shall only enter boxes by means of couplers and bushes.

### 1.9 CAPACITIES OF NON-METALLIC AND STEEL CONDUITS

The cable shall be run in the conduits so as not to exceed the capacities as set in latest edition of IEE Regulations. For groups of cables, the numbers and sizes of cables installed shall be such that a space factor of 40% is not exceeded.

Conduits of sizes less than 19mm shall not be used without the written authority of the Engineer.

### 1.10 PVC INSULATED CABLES AND FLEXIBLE CORDS

All cables used in this contract shall be manufactured in accordance with the current appropriate Kenya Standard Specifications and British Standard. The standards are:

- PVC insulated cables and Flexible Cords Ks 04-192:1988 or BS 6004
- PVC insulated Armoured Cables KS 04-194: 1990 or BS 6346
- Armouring of electrical cables KS 04-290: 1987

The electrical contractor will be required to submit samples of cables for the Engineer’s approval; the Engineer reserves the right to take the samples to Kenya Bureau of Standard for testing at contractor’s expense. If the supplied cables fail to meet the required standard the Engineer reserves the right to call for installation of cables of an alternative manufacture without any extra cost being incurred.

PVC installed cables shall be 100/1000 volt grade. No cable smaller than 1.5mm\(^2\) shall be used unless otherwise specified. The colour of cables shall conform to the details stated in the “cable markers and installation colours” Clause 1.14

### 1.11 INSTALLATION OF CABLES
(i) In wiring system where cables will be drawn in conduit, it is only after the conduit system has been completely installed, cleansed of bungs, burrs and building debris and moisture free, shall the cables be drawn into conduits.

(ii) The type of insulation protective cover, if any, shall be selected so as to allow compliance and precautions be taken against Mechanical damage, damage by heat, damage by fire or explosion, damage by dampness or corrosive atmosphere and electrical leakage.

(iii) For these general specifications unless otherwise specified all cables shall be of copper conductors and PVC insulated. All final sub-circuit cables shall be copper conductors with PVC insulation. Conductors for main and sub-mains distribution shall however be either copper or aluminium and PVC insulation as shown in the contract drawings.

(iv) Cable sizes shall be those specified in the contract drawings and Bills of Quantities but the lowest size of cable shall not be less than 1.5mm$^2$.

(v) All cables shall be suitable for operation at system voltage and be able to withstand currents equivalent to those specified for the current protective devices.

(vi) All cables connected in parallel circuit shall be of the same size and length to ensure proper division of the current.

(vii) Special care shall be exercised when terminating aluminium conductors. Such conductors shall not be placed in contact with terminal of brass or other metal having high copper content unless the terminal is suitably constructed to prevent electrolytic corrosion.

(viii) Conductors terminated in a pillar type terminal shall be mechanically swaged and fitted with a phosphor bronze sleeve whilst those to be terminated with lugs shall have these lugs fitted to them with a purpose made compression tool.

(ix) Cables shall be drawn into conduits by means of draw steel tape unless otherwise specified. However where there are numerous inspection boxes, it may not be necessary to employ draw wires or tapes. Where draw wires are to be used to draw cables into conduits, they shall be inserted during the erection of the conduit.

(x) All cables drawn must not twist round each other but must be parallel throughout the run. Care should be taken to ensure cable insulation is not mechanically damaged when drawing the cables. Cables whose insulation has been damaged in any part of the length shall not be taped or shrouded but the whole length shall be replaced in full. No cable joints shall be permitted along the length of the conduit but joints shall only be made at terminal boxes.

(xi) For these general specifications, wiring shall be carried out on the looping-in principal. All joints shall be made at the terminals of the main switches, distribution boards, ceiling roses, switches, sockets outlets and fixed apparatus only. No joint shall be permitted in inspection boxes, but jointing of cables shall be permitted at terminal boxes. No joints shall be made in any other boxes unless approved and no joints shall be drawn into conduit.
1.12 ARMoured PVC Insulated and Sheathed Cables, Cable Markers and Tiles

(i) Unless otherwise stated, armoured cables shall be of copper conductors of PVC SWA PVC type having a rating of 600/1000 volts and manufactured to KS 04-194: 1988 and KS 04-187/1988 with an overall extruded PVC insulation covering.

(ii) The Steel Wire Armour (SWA) of the cable shall be used wholly as an earth continuity conductor and the resistance of the wire armour shall not be more than twice of the largest current carrying conductor of the cable.

(iii) PVC/SWA/PVC cables shall be terminated using approved glands and a PVC tapered sleeve shall be provided to shroud each gland.

(iv) Where cables rise from floor level to switch gears etc. they shall be protected by PVC conduit to a height of 600mm from finished floor level, whether the cable is run on the surface or recessed into the wall.

(v) Where PVC/SWA/PVC cables are outside the building they shall be laid underground 750mm deep with protecting concrete interlocking cover tiles. The concrete tiles shall be 300mm by 150mm and with a minimum thickness of 25mm and of concrete mix of 1:2:4. The tiles shall be labelled ‘HATARI’. The cables shall be laid on 50mm of sifted soil then covered with 50mm of sifted soil and interlocking tiles. The trench shall be carefully backfilled. As a caution cables shall be snaked along their route to allow for ground subsidence or settlement and a 2% allowance shall be given on the measured route length before backfilling.

(vi) The electrical contractor will carry out all necessary excavations and reinstatement of ground. The cover tiles shall be continuous and without gaps between.

(vii) Where armoured cable is specified on the contract drawings, the electrical contractor shall ensure continuity of the armouring and its cross bonding to other metal work and services.

(viii) All PVC/SWA/PVC cables run inside the building shall be fixed in rising ducts or on ceilings by means of die cast cables hooks or clamps, of appropriate size to suit cables, fixed by studs and back nuts to their channel sections support. The channel sections shall be fixed at an interval of 1500mm by means of rawlbolts for concrete ceiling, or wall and appropriate screws for wooden ceiling.

(ix) Where the cables are to be suspended from the concrete ceiling or wall, fixing shall be by BICC claw type cleating system with die-cast cleats and galvanised mild steel back straps or similar approved equal method. For one or two cables run together the cleats shall be fixed on a special channel section supports or backstraps which shall in turn be secured to walls or ceilings of ducts by rawlbolts.

(x) In excessively damp or corrosive atmospheric conditions special finishes may be required and the electrical contractor shall apply to the Engineer for further instructions before ordering cleats and channels for such areas. The above type of hooks and clamps and channels or cleats and back straps shall also be used for securing cables in vertical ducts.
(xi) Precaution should be taken when handling PVC insulated and / or sheathed cables during period of low temperatures to avoid mechanical damage as PVC insulation cracks due to very low temperatures.

(xii) Armoured cables, which might otherwise come into contact with fixed metal works, shall either be segregated or effectively bonded to prevent appreciable voltage difference at such possible points of contact.

(xiii) Where cable pass under roadways, ducts as specified on the contract drawings shall be provided. Cable route markers shall be provided to indicate the route of the underground cable as specified in the contract drawings or as required by the Engineer. After installation of armoured cables they shall be tested in accordance with GES No. 2 and the result recorded.

(xiv) Single core steel armoured cables shall not be installed in cases where the current is alternating current. (NB: if copper cable is used then the armour should be aluminium otherwise use multicore cable for magnetic fields to cancel out)

1.13 CABLE MARKERS AND IDENTIFICATION COLOURS

(i) All cables ends connected in switchgear, Main Distribution Board, panels etc. shall have the insulation carefully cut back and the ends sealed with hellerman rubber slip as cable end markers. The markers shall be of appropriate phase colour. The insulation cable colours and cable end markers shall be in accordance with details stated below unless otherwise specified.

(ii) Every cable used for wiring shall be identified at its terminations throughout in length by colour of its insulation and / or cable end markers.

(iii) The method of identification shall be as below:

<table>
<thead>
<tr>
<th>Final Sub Circuit</th>
<th>Cable end markers</th>
<th>Cable insulation Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single phase</td>
<td></td>
<td></td>
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<tr>
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<td>red</td>
</tr>
<tr>
<td>b) Neutral</td>
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<td>black</td>
</tr>
<tr>
<td>c) Earth</td>
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<td>c) Earth</td>
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Three Phase & Neutral Multicore Cable

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iv) Where multicore armoured cables have the same insulation colours the cable shall be numbered with 1, 2, and 3 to signify live phase conductors and the number 0 shall be for the neutral cable. The cable end makers shall be insulation sleeves of appropriate colours or discs.

v) All cores of flexible cable including flexible cord shall be coloured throughout in accordance to the table below.

FLEXIBLE CABLE OR CORD

vi) Bare conductors shall be made identifiable where necessary by painting with those colours.

v) Where identification markers are used, these shall be machine made from non-deteriorating black trifoliate or similar material and be machine engraved indicating the phase of the cable.

1.14 CABLE SUPPORT

i) To ensure there is no appreciable mechanical strain on any cable termination adequate support shall be provided to conduits runs with cables drawn in them.

ii) Where conduits vertical runs exceed 5 metres there shall be a horizontal bend, which shall be supported as a precaution against undue compression of the insulation of the cable.

iii) Cables laid on trunking with vertical runs exceeding 5m in length shall also have adequately intermediate support. All PVC/SWA/PVC cables in horizontal runs in accessible trunking shall be supported by clips at spacing not exceeding the appropriate value stated in table B.2M of the IEE regulation.
iv) Where it is in an inaccessible position and unlikely to be disturbed support shall be provided at the top of the run by a clip and a rounded support of a radius not less than the appropriate value stated in table B.IM of IEE regulations.

1.15 CABLE LENGTHS, TYPES, SIZES, TERMINATIONS AND JOINTS

(i) The cable type and sizes shall be as specified in contract drawings.

(ii) The length of the cable shall be as measured from supply point (meter board, distribution board, consumer unit etc) to the intended terminal point (switches, lighting, fitting, apparatus etc). No joint shall be allowed in between. The electrical contractor shall be deemed to have allowed for supply of sufficient cable lengths of each type and size to complete wiring system and for making allowances for any additional lengths due to cutting and waste.

(iii) All terminations of cable conductors and bare conductors shall be mechanically and electrically sound. Care should be taken to ensure there is no undue mechanical pressure applied to the conductor by over tightening of a clamping screw or others. The terminal point shall have anchors to secure all the wires. The electrical contractor shall allow sufficient length of cable inside the termination points to avoid undue strain of cables when terminating.

(iv) At every cable termination, the insulation shall be removed no further than is necessary. For braided, taped, sheathed or armoured cables the sheath shall be cut as far back from the end of the conductor insulation as may be necessary to prevent undue leakage from live parts of the braid, tape, sheath or armour.

(v) Where soldering is to be used for termination the type of solder fluxes shall be non-acidic or corrosive. Cores of sheathed cables from which the sheath has been removed and non-sheathed cables at the termination of the conduit duct or trunking shall be enclosed in a non-combustible material. In dump situation the enclosure shall be damp and dust proof and corrosive resistant.

(vi) In a flammable and/or explosive dust, flammable volatile liquid or vapours or gas situation termination shall be avoided but if necessary the terminations shall be enclosed in a flameproof fitting complying with BS.229.

(vii) Cable glands shall regularly retain the outer sheath or armour of the armoured cable without damage and shall incorporate adequate means of maintaining earth continuity between the armour and the threaded fixing component of the gland.

(viii) In termination point where high temperatures are to be encountered insulating sleeves or beads suitable for such temperatures shall be fitted over the individual cores of the cables or flexible cord in such a way that the normal insulation of the cores is not affected by the temperatures and are relied upon to prevent a short circuit between conductors and metallic part of termination enclosure or cause earth fault.

(ix) Terminations of mineral insulated cables shall be provided with sleeves having temperatures rating similar to that of the seals. Bare conductors in terminations of switches, bushes, consumer units etc. which are expected in normal service, shall be protected against accidental contact by screens or barriers or by adequate clearance. Special care shall be exercised when terminating Aluminium conductors. No overdue mechanical pressure should be applied on its conductor by over tightening of the
clamping screw. Aluminium conductor shall not be placed in contact with a terminal of brass or other metal having a high copper content to avoid corrosion.

1.16 **SUB-CIRCUITS**

**Sub-Mains**

These shall be sub-circuits running from fuses or circuit breakers on the main switchboard or meter box to distribution boards or consumer units, and the cable sizes for these circuits shall be as to comply with IEE regulations and as shown in the contract drawings. No cables less than 4mm² shall be used in these sub-mains circuits. Live, neutral, and earth continuity conductors, for these circuits shall all be drawn in the same conduit or enclosure.

**Final Sub-Circuit-General**

i) General or consumer circuit final sub-circuit from one distribution board will not serve outlets in an area served by another distribution board or consumer unit fed from the same meter.

ii) No fuse or circuit breakers shall be installed at any point other than on a distribution board, consumer unit, switch fuse or main switchboard except for fused spur boxes.

iii) Bell transformers shall be connected to separate way of a distribution board and form a separate final sub-circuit.

iv) Fire alarms systems shall also be from a separate final sub-circuit.

v) When the sub-main circuit protection comprises HRC fuses, final sub-circuit protection shall either be fuses or MCB’s

vi) In all final sub circuits the neutral conductors shall be connected at the distribution board in the same order as that in which the live conductors are connected to the protective devices. All final sub-circuits for lighting points, sockets outlets points etc, wiring shall be carried out in the loop-in-system with no joints whatsoever along the run of cables.

vii) Each final sub-circuit shall be adequately protected against excess current and voltage at the beginning of the circuit. The size of the protective devices for each final sub-circuit shall be as shown in the drawings.

**Lighting final sub-circuits**

i) All lighting points shall be wired with cables not less than 1.5mm² in size. Each final sub-circuit number for lighting points, in the drawing, indicate lighting points which shall be served or connected to the same final sub-circuit and protected by the same protective device.

ii) No lighting circuit shall comprise more than 20 points when protected by 10A MCB.

iii) All lighting fittings with metal enclosure shall be provided with an earth terminal, which shall be connected, to earth continuity conductor of the same size as the live
conductor cable. The earth continuity conductor shall be looped to all such fittings in the same manner as the live and neutral conductor.

iv) All lighting fittings shown in the drawings as being switched by the same switches shall be so wired as to be switched and controlled by the same switch.

(iv) Ring final sub-circuit for socket outlets

The ring sub-circuit shall run in the form of a ring commencing from a way in a distribution board or consumer unit etc. looping into the terminals of socket outlets and returning to the same way of the distribution board or consumer unit etc. The earth continuity conductors shall also run in the form of a ring having both ends connected to earth terminal at the distribution board or consumer unit etc.

The protective device for the final ring sub-circuit for socket outlet or any power points shall be as shown in the contract drawings.

1.17 EARTHING

The earthing of the installation shall comply with the following requirements: -

a) (i) it shall be carried out in accordance with the appropriate sections of the current edition of the regulations for Electrical Engineers of Britain.

(ii) Electricity Supply Authority bylaws.

b) (i) Every item of apparatus and every conductor operating at voltage exceeding extract low voltage shall be effectively protected from giving rise to dangerous earth leakage current.

(ii) all metal required to be earthed under statutory rules shall be effectively earthed.

c) (i) all consumers units, Distribution Boards metal boards and switchgear shall have earthing busbar terminal. Throughout every circuit of such an installation an earth continuity conductor shall be provided and connected to the consumer’s earthing terminal.

(ii) All exposed metalwork of all apparatus in electrical installation shall be connected to the appropriate earth continuity conductors.

(iii) All metal works of wiring systems other than current carrying parts, including cable sheaths armour, conduit, ducts, trunking, boxes, and catenary wires shall be connected to the appropriate earth continuity conductors.

(iv) The earthing terminal of every socket outlet shall be connected to the earthing continuity conductor of the final sub-circuit. At every lighting point an earthing terminal shall be provided and connected to the earthing continuity conductor of the final sub-circuit unless the fitting is of all insulated enclosure.

(v) Metal works other than current carrying parts and one point of the secondary winding of any transformer shall be connected to the appropriate earth-continuity conductors unless otherwise specified.
d) (i) At all main distribution panels and main services position, a 25mm x 3mm minimum cross section area copper tape (earth busbar) shall be provided and all equipment including the lead sheath and armouring of cable distribution boards and metal frames shall be bonded thereto.

(ii) The earth tape (earth busbar) of the consumer earthing terminal in Clause d(i) above shall be connected to the earth electrode by means of a copper tape or cable of suitable cross sectional area (earth lead). The minimum cross sectional area of the earth lead shall be 2.5mm and the maximum being 70mm². The connection of the earthing lead to the earth electrode must be readily accessible and soundly made by soldered joint or clamp. The size of earth lead cable or tape shall be as specified in the contract drawings.

(iii) Where the earth electrode is located outside the building, a removable test link shall be provided inside the building as near as possible to the entry of the tape for isolating the electrode for testing purposes.

(iv) Where necessary, earthing connection shall be protected against chemical damage and corrosion.

(v) All tapes to be soft high conductivity copper, untinned except in corrosive sites or where otherwise specified and where run underground, on or through walls, floors etc. it shall be served with corrosion resisting sleeve or coated with corrosion compound and braided

(vi) Where an earth rod is used for earthing its earth resistance shall be tested in the manner described in the latest edition of the IEE regulation in the presence of the Engineer. The sub-contractor shall provide test equipment.

(vii) Where copper tape is fixed to the building structure it shall be by means of purpose made non ferrous saddles which space the conductor away from the structure at a minimum distance of 10mm. Fixings shall be made using purpose made plugs. No fixing requiring holes to be drilled through the tape will be accepted.

(viii) Joints in copper tape shall be tinned before assembly fitted with a minimum of two copper rivets and seated solid.

(ix) Where connections are made to the earth busbars connecting surface shall be tinned and bolts and nuts shall be of copper or brass. Cables to be bolted to the bus bars shall have appropriate termination non-ferrous lags.

(x) The earth rod shall be 1.5m long by 15mm diameter extensible type. The head of the earth rod shall be driven to 300mm below the surface of the ground and enclosed in a concrete box with concrete inspection covers, that is, Earth Inspection Chamber, as per contract drawings. The rod shall be fitted with hardened steel tip and driving caps and appropriate cable clamp of copper

(xi) In rocky soils conditions the electrical contractor shall obtain approval from the Engineer for an alternative earthing system.

(xii) All Consumer Units, Distribution Boards and switchgear shall have earthing busbars terminal.
(xiii) Should the site condition be such that no effective earthing can be achieved by means of earth electrode rod the Engineer shall instruct the electrical contractor the alternative earthing system.

1.18 **BONDING**

(i) All metallic conduits, trunking, metal enclosure, the metallic sheathing of cables, the cases and enclosures of switchgear boxes fusegears and apparatus of an electrical nature, shall be so bonded as to be directly connected to the respective consumer’s earth.

(ii) All earthing terminals of every socket outlet and lighting point shall be connected to earth conductivity conductor of the final sub-circuit. Earthing assessments and the resistance of the earth continuity conductor shall comply with IEE regulations.

(iii) All lighting switches shall have earthing terminal, which shall be connected to earth continuity conductor unless the switch plates themselves are of plastic moulded type.

(iv) All metallic work shall be bonded by earth continuity conductor expect where the metallic works is in isolation or is to be isolated.

(v) Isolated switches and incandescent lighting fittings using filament lamps installed above non-conducting ceiling need not be bonded.

(vi) The bonding connection to water and gas services (if any) shall be made as near as practicable to the point of entry of these services into the premises.

(vii) All consumer metal shall also be bonded. The minimum size of copper bonding lead to bond metalwork shall be 2.5mm².

(viii) To avoid a situation where fortuitous faulty contact can occur between electrical apparatus and live conductors, metal works of the apparatus shall be bonded.

(ix) The bonding and connections to earth continuity conductor shall be such that no fault of negative impedance of earthed metal work shall be sustained so as to cause danger and electric shock or the risk.

(x) No bonding to metal works, water pipes, or members of structural metal works shall be done before the earth continuity conductor is connected to effective earthing installation.

1.19 **PROTECTIVE MULTIPLE EARTHING**

Where protective multiple earthing (PME) is provided by the Supply Undertaker, the earthing lead shall be connected to the consumer’s earthing terminal together with the neutral conductor of the installation and all shall be so arranged that connection to the neutral conductor of the incoming supply can be carried out linking the earth terminal of the consumer to the neutral terminal of the Supply Undertaker.

1.20 **STEEL CONDUITS AND STEEL TRUNKING**
a) Where metal conduits and fittings are to be used they shall be of heavy gauge annealed mild steel Class “B” welded or solid drawn to standard specification KS-04-180: 1985 or BS 1387. In no case will conduit smaller than 20mm diameter is to be used on the works. Conduits installed within buildings shall be black enameled finish except where specified otherwise. Where installed externally or in damp conditions they shall be galvanized. Conduit fittings, accessories or equipment used in conjunction with galvanized conduits shall also be galvanized.

b) Metal conduit systems shall be electrically continuous and earthed in accordance to IEE regulations section D. All joints shall be made mechanically and electrically continuous by screwing to steel socket or by substantial mechanically clamps and ensuring the threaded joints do not corrode by applying a coat of paint of aluminium or iron oxide. Cables installed in steel conduits shall always be so bunched that the cables of all phases and the neutral conductor (if any) are contained in the same conduit.

c) Where vertical sections of steel conduit used exceed 5m in length staggered bends with draw-in boxes shall be provided at 5m interval to support the weight of the cables.

d) Metal trunking shall be fabricated from mild steel of not less than 18SWG. All sections of trunking shall be rigidly fixed together and attached to the framework of fabric of the building at intervals of not less than 1.2. Jointed trunking shall not have overhang-fixing points of more than 0.5m.

e) All metal trunking shall be made electrically continuous by means of 25x3mm copper links across each joint and where the joints are galvanised the links shall be made by galvanized flat iron strips.

f) All trunking fittings (i.e. bends, tees, etc) shall leave the main trunking completely clear of obstructions, be continuously open except through walls and floors at which points suitable fire resisting barriers shall be provided as may be necessary. The inner edge of bends and tees shall be chamfered where cables large than 35mm$^2$ are employed.

g) Where trunking passes through ceilings and walls it shall be properly secured and the cover solidly fixed. Screws and bolts securing covers to trunking or section of covers together shall be so arranged that damage to cables cannot occur either when fixing covers or when installing cables in the trough.

h) Where trunking is used to connect switchgear of fuseboards, such connections shall be made by trunking fittings manufactured for this purpose and not by multiple conduit couplings.

i) Where the wiring system incorporates galvanized conduit the trunking system shall also be galvanized and where the conduit system shall be painted, the trunking systems shall also be painted.

j) The number of cables to be installed in trunking shall be such as to permit easy drawing in without damage to the cables and shall in no circumstances be such that a space factor of 45% is exceeded. All cables shall be drawn or laid in trunking trough in parallel and untwisted.

k) Where conduits terminate in fuse gear, distribution boards, adaptable boxes, non-sprouted switch boxes etc. they shall, unless otherwise stated, be by means of a socket and bare male brass bushes, compression washers or couplers and male brass bushes.
All exposed threads and abrasions shall be painted using an oil paint for black enamelled tubing, aluminium paint or other approved corrosive resistant paints.

l) All bends and sets shall be made cold without altering the section of the conduit by means of approved pipe bending machine. The inner radius of the bend shall not be less than four (4) times the outside diameter of the conduit. Not more than two right angle bends will be permitted in a conduit run without draw-in box. No tee, elbows, sleeves either of inspection or solid type will be permitted as part of conduit installation. Where straight runs of conduit are installed, draw-in-boxes shall be provided at distances not exceeding 5metres.

m) Conduit shall be swabbed out prior to drawing in cables and they shall be laid so as to drain of all condensed moisture without injury to end connections.

n) All boxes shall conform to KS04-668: 1986, be malleable iron and black enamelled or galvanized according to the type of conduit specified. All conduit boxes shall have threaded brass inserts. Box covers where required shall be of heavy guage metal, secured by means of zinc plated or cadmium plated steel screws.

o) Boxes used on surface installation works shall be tapped or drilled to line up with the conduit fixed with spacer type saddles, allowing clearance between conduit and wall, without the need for setting the conduit.

p) Where used in conjunction with mineral insulated copper sheathed cable, galvanizes boxes shall be used and painted after erection.

q) Draw-in-boxes in the floors are generally to be avoided but where they are essential they must be grouped in positions approved by the Engineer and covered by a suitable floor traps, with non-ferrous trays and covers. The covers are to be recessed and fitted in with a material to match the floor surface.

r) Where buried in the ground outside the building the whole of the buried conduit is to be painted with two coats of approved bitumastic composition paint before covering up. Where run on the surface, unpainted fittings and joints shall be painted with two coats of oil bound enamel applied to dust and grease free metalwork.

s) Non-inspection bends shall only be used in special circumstances such as behind a lighting fitting or outer box.

t) When drawing cables into the conduit care must be taken to ensure that they are drawn in parallel throughout the conduit run with no cables twisted round each other.

u) Steel conduits must not be in contact with water pipes, gas pipes or alarm circuits, radio or telephone circuits or other metal works, and where this is unavoidable the conduits shall be bonded to the metalwork of this circuits. All conduits unless installed to be gas-tight must be self-ventilating and provided with means of drawing condensed moistures. Where conduit passes through a wall, ceiling or floor the hole must be made good to full thickness of the material of which the wall or partitions are build.

v) A square adaptable box shall be used where a number of conduits running together change direction. Proper mechanically and electrical continuity must be maintained when using such boxes.
w) Where extra low voltage cables such as telephone services, radio services alarm circuits, run in the same direction with low voltage cables for lighting or for power each category of the cables shall be segregated and run in different compartments or channel of the trunking.

1.21 CABLE DUCTS

i) The electrical contractor shall provide and lay pitch fibre or concrete cement ducts under roadways, concrete walkways etc., through which cables are to be routed. Where called upon the electrical contractor shall haunch or place concrete around the ducts to protect the ducts.

ii) The building contractor will supply and install ducts where required in footings of buildings but it will be the electrical contractor’s responsibility to provide accurate details to the building contractor of the required positions of these ducts and to ascertain that they are laid to the correct falls.

iii) After the installation of cable all ducts shall be adequately sealed to restrict the ingress of moisture. The number of cables to be installed in ducts shall be specified in the contract drawings but where not specified they shall be such as to permit easy drawing-in without damage to the cables and a space factor of 35% will not be exceeded.

1.22 MV MAIN SWITCHBOARDS AND SWITCHGEAR

The Main Switchboard is intended to ensure safety during operation, inspection, cleaning and maintenance of the entire electrical installation of the building protected by the board. The Board shall be so arranged as to minimise the risk of fire arising and spreading. It shall incorporate means of insulation, excess-current protection and earth leakage protection of the entire electrical installation.

a) Switchboard Construction

i) The switchboard shall be of free standing type manufactured in accordance with KS04-226, 1985(or BS 162), which coordinates the requirements for electrical power switchgear and associated apparatus. It is not intended that this K.S should cover the requirements for specified apparatus for which separate Kenyan Standard exist. All the other equipment and materials used in the switchboard shall be in accordance with appropriate Kenya Bureau Standard.

ii) The switchboard shall comprise the equipment shown on the drawings together with all current transformers, auxiliary fuses, labels, small wiring, measuring instruments, if any, and interconnections necessary for the satisfactory operation of the switchboard.

iii) The main switchboard shall be of modular construction type, of flush fronted, enclosed back, connected, all of steel construction and neat appearance, painted, with full front or rear access or both, as called for in the particular specifications. It shall be suitable for indoor use, sectionised as necessary to facilities easy transportation and erection. The switchboard shall first be assembled at the factory, fully wired and checked before being installed on site in order to minimize installation work.
iv) It shall be floor mounted with maximum height of the switchboard being approximately 2.0 metres. A suitable connection chamber containing all field terminals shall be provided at the top or bottom or special chamber of the switchboard as appropriate.

v) Before manufacturing the electrical contractor shall submit to the Engineer for approval of detailed drawings, showing the layout construction and connection of the switchboard.

vi) Unless otherwise specified the switchboard shall be constructed from not less than 10 guage welded bright zinc plated mild steel for frame work and structural sections, and 12 gauge zinc plated steel sheet for doors and panels which shall be adequately stiffened by folding or welded stiffeners. All doors shall be properly stiffened and fitted with heavy cadmium plated or any other non-corrosive concealed hinges and flush catches. Removable stiffened zinc plated steel sheets covers shall be provided elsewhere on the switchboard for full access. All doors and covers shall be fitted with cemented neoprene gasket seals to provide a dust proof enclosure. All hardware and fastening shall be heavily cadmium plated or any other non-corrosive fasteners.

vii) No self-tapping screws shall be used. All steelwork shall be clean and free of burrs, scale and blemishes with all raw edges hidden and shall be finished with rust inhibiting treatment, one primer or undercoat and final coat of first quality zinc powder sprayed and baking enamel finish the colour of which shall be to approval.

viii) The switchboard shall be arranged to provide the maximum of safety to personnel and equipment. All electrical wiring and busbars shall be completely enclosed, closure panel, isolating and insulating barriers, and interlocks shall be provided as required for maximum safety. All fuse switches or switch fuses shall be capable of being padlocked in “off” and the “on” positions.

ix) The switchboard shall have provision of removable cross sections for easier cable installation and termination, adequate supports shall be provided for all busbars. Other terminations shall also be provided with adequate support.

x) All switches shall be operatable from floor level with maximum height of the switchboard not exceeding 2500mm from the floor level. The flush mounted indicating meters shall be within 1650mm height.

xi) Mounting arrangements shall be such that individual complete fuse switches or switch fuse may be disconnected and withdrawn when necessary without extensive dismantling work. When switches are arranged in their formation all-necessary horizontal and vertical barriers shall be provided to ensure segregation from adjacent units.

xii) Where spaces on the switchboard are provided for future circuit components to be installed, as shown on the drawings, all ancillary parts shall be provided and installed so that future components may be installed and connected in the least time possible. Full safety precautions shall be provided with all such spaces.

xiii) The mild zinc plated steel angle or channel forming the bottom rear edge (for rear access switchboard) or bottom front edge (for front access switchboard) shall be made up in sections and bolted into position such that any one section may be removed to facilitate installation of cables.
b) Busbars-General

(i) All busbars shall be of high conductivity copper and be provided in accordance with KS 04-226: 1985 (or BS 158 and BS 159). The busbars shall be clearly marked or painted with the appropriate phase and neutral colours, which should be red, yellow, blue for live phases and black for neutral. The switchboard shall be such that the busbars are so arranged that the extensions to the left and right may be made in the future with ease should this need arise.

(ii) The busbars, busbar connections and bare conductors forming part of the equipment of the switchboard shall be of current ratings as specified in the drawings, they shall also be able to withstand temperatures limits encountered during the normal operations of the switchboard and comply with BS. 159.

(iii) Each busbar shall be of adequate strength to withstand the electro-mechanical forces that may be set up by the designed prospective short circuit fault current and they shall be so installed that they are free to expand and contract as the temperature changes without any damage to themselves or to any other part of the installation.

(iv) The busbars shall be mounted fully enclosed within the main enclosure of the switchboard in separate chambers. They shall be fully separated from the incoming and outgoing cable areas. Except for instruments, potential or current connections to fuse switches, switch fuses etc., which shall be clamped in position and be of minimum length, no circuit wiring shall be within the busbar chamber.

(v) Most parts of the busbars shall be sheathed in approved, insulating materials in their respective phase colours and secondary insulation shall be provided where they pass through supports to prevent tracing paths.

(vi) Interconnections between busbars and switchgears shall be of minimum length, properly insulated and rigidly supported. All contact areas of the busbars and the connection fastened to the busbars shall be either be of heavily silver-plated or solid copper bolts. Joints and connections shall be rigidly made with clamps and high tensile zinc plated steel bolts and nuts used with spring washers to maintain uniform pressure and flat washers to prevent cupping. Ready access to all joints and connection shall be provided. Bare aluminium conductors when terminated into copper busbars shall be suitably protected against corrosion.

(vii) The busbars and its interconnections shall be mounted and screened such that with fuse switch or switchfuse door open it shall not be possible to make contact with live parts. All cables terminations shall have PVC deep moulded shrouds to prevent contact with live parts.

(viii) Small wiring emanating from busbars will be neatly arranged, cleated and shall be arranged in accordance with BS 158, the insulation of the wiring shall be coloured according to whether it is phase or neutral cable.

c) Phase Busbars

Termination of cables conductors on all phase busbars and all other busbars shall be through suitable manufactured technical clips. No holes shall be drilled on busbars for the purpose of terminating cables conductors. The clips shall be of cadmium plated,
silver plated steel or pure copper suitable to match busbar materials to avoid corrosion in damp conditions.

d) Earth Bars

i) A high conductivity copper earth bars of adequate current rating for the anticipated earth fault current, shall be installed the full length of the switchboard in the outgoing cable area within the switchboard enclosure.

ii) Connection to the earth bar shall be made with approved cable lugs and high tensile terminal clips with galvanised steel nuts and bolts with washers as specified for the phase busbars. No holes shall be drilled on the busbars for the purpose of terminating cables on the busbars.

Neutral Bars

i) A high conductivity copper neutral bar adequately rated and supported for normal and fault conditions shall be installed in the outgoing cable area in the switchboard enclosure. These bars shall be mounted on insulators and shall be divided into sections according to the design of the switchboard. Copper links double bolted to each section shall connect the section.

ii) Connection on the neutral bars shall be made as specified for the phase busbars. All points of contact on the neutral bars shall be silver-plated.

1.23 Labels

(i) Switchgear, distribution Boards, consumer Units

i) All switchgear distribution boards consumer units etc. shall be clearly and properly labelled in accordance with IEE regulations. Fuse ways and circuit breakers feeding final sub-circuit shall be labelled to indicate power or lighting sub-circuit, the area served, or the equipment served, the circuit number etc., the details of which shall be as given in the contract drawings.

ii) This shall be done by writing neatly on the label normally provided on the distribution boards consumer units etc., the area served and the circuit number etc., with a ball pen (not pencil or felt tip). If no label is provided the electrical contractor shall fix a special made label of the “trifoliyte” type. (Dymotape will not be accepted)

iii) The outside cover of all switchgear, distribution boards, consumer units etc shall be clearly labelled with a “trifoliyte” type label (not dymotape) showing the service provided and any circuit reference number which may be given in the drawings current rating etc.

(ii) Switchgear, switch fuse, switches and isolators

a) Switches or circuit breakers the purpose of which is not obvious shall be labelled to indicate equipment, appliances or apparatus it controls.
b) In labelling Switch fuse, fuse switches and isolators the information required shall include:-

i) Reference number of switch

ii) Special current rating

iii) Where circuit cables have been rated on the basis of close circuit protection the label shall include indication that the fusing factor must not exceed 1.5. in this case labelling shall be of ivorine engraved block on white plate screwed by R.H brass screws

iv) Where more than one phase of supply shall be brought into a multi gang switch box a label shall be fixed to show maximum voltage present and labelled “DANGER”.

All labelling shall be completed before testing commences and the Engineer will accept no test certificates unless this has been done. Other labels shall be fixed where deemed fit and as instructed by the Engineer.
1.24 DISTRIBUTION BOARDS AND CONSUMER UNITS

(i) All enclosures of distribution boards and consumer units shall be metallic with the case made of zinc metal clad steel sheet (galvanised), or zinc powder coated steel sheets. They shall be of surface or recessed mounting pattern. They shall have hinged lids fitted with foam rubber gasket, with enamelled finish. Where called for in the specification, the cases shall be provided with locks.

(ii) Removable undrilled gland plate shall be provided on the top and bottom of the cases for incoming cable terminations. Where the requirement for fuses is indicated on the contract drawings the distribution board shall be fitted with high quality porcelain fuse carriers and bases lined with heatproof material, and removable insulated shields or shrouds to provide adequate protection against accidental contacts with live metal. They shall also have circuit-indicating labels fixed inside the cover. Such Distribution board shall be complete with HRC fuses to B.586 1952 category 440 volts A.C.5

(iii) Where the requirement for Miniature Circuit Beakers (MCBs) is indicated in the contract drawings the Distribution Boards shall be fitted with moulded thermoplastic units of the combined thermal overload and magnetic short circuit tripping type to KS O4-311 Part 1 1987 or B.S 3871 part 1, having a minimum short circuit breaking capacity of 3000 Amps (3KA). The tripping mechanism shall be of inverse characteristics to prevent temporary overloads tripping and shall not be affected by normal variation in ambient temperature. The operating dolly shall be trip free with a positive movement in both make and break position. Clear indication of the position of the handle "ON and OFF" shall be incorporated.

(iv) In all the distribution Boards a complete list of circuits detailed on typed cartridge paper glued to stiff cardboards and covered with a sheet of Perspex and held in position with four suitable fixings, shall be fitted to the inner face of lids. The appropriate HRC fuse or MCB ratings shall be stated on the circuit chart against each circuit in use. Insulated barriers shall be fitted between phases and neutrals in all boards to shroud live parts. Neutral cables shall not be connected to fuses or MCB’s. This shall also apply to earth bars.

(v) All consumer units shall be metal clad steel sheet or zinc-coated sheet of steel enamelled with hinged covers. They shall be either flush or surface mounted. They shall be suitable to be fitted with MCB’s. All metallic cases of distribution boards and consumer units shall be effectively bonded to earth continuity conductor.

(vi) The Engineer has already carried out short circuit level calculations when preparing contract drawings but the electrical contractor is advised to check or calculate and assure himself that the prospective fault currents at each level does not exceed the short circuit protection capability of the switch or distribution gears he intends to install as it is his responsibility to sign the appropriate declaration in accordance with section E of the IEE regulations.

1.25 METAL CONTROL PILLAR

i) These shall be metal clad and fabricated with zinc coated steel sheet 12SWG gauge with enamelled finish of corrosive resistant paint as per contract drawings. The electrical contractor shall supply, install test and commission control pillars including supplying, fixing and connecting switchgears as detailed on the appropriate drawings.
The control pillar shall be bonded with earth continuity conductor to comply with IEE regulations. It shall be so constructed as not allow ingestion of moisture into the enclosed switchgears. All cables shall enter the enclosure from below the pillar. All control pillars shall be vandal proof with hinged lockable doors.

1.26 **FUSED SWITCHGEAR AND ISOLATORS**

All fused switchgear and isolators shall conform to the requirements of KS04-226 PART 1:1985, or KS IEC 60439 Part 1-5. all contacts are to be fully shrouded and are to have a breaking capacity on manual operations as required by KS-04-182: 1980.

i) Fuse links for fused switches are to be of high rupturing capacity cartridge type class 21 confirming to KS04-183: 1978 or BS 88.

c) The Isolators and fuse links shall be contained in metal clad, dust proof, gasket sealed individual enclosures. Isolators shall be load breaking/ fault breaking isolators without fuses. The fuse links shall be contained in metal clad, dust proof, gasket sealed individual enclosures. Mechanical interlocks are to be provided between the door and, main switch operating mechanism shall be so arranged that the door may not be opened with the switch in the “ON” position, similarly it shall not be possible to close the switch with the door open except that provision to defeat the mechanical interlock and close the switch with the door in the open position for test purposes. The “ON” and OFF positions of all switches and isolators shall be clearly indicated by a mechanical flag indicator or similar device.

a. 

ii) In T.P.N fused switch units, bolted neutral links are to be fitted.

iii) The fuse switch units shall have fault rating at least equal to the fault rating of the switchboard in which they are to be installed. It shall have fast make/break design suitable for on board operations.

v) The handles of the fuse switch shall be non-detachable steel handles capable of being locked in either the “on” or the “off” position. The switch contacts shall be separately and fully shrouded and shall be renewable.

vi) The fuses and miniature circuit breakers (MCBS) shall be the protective devices to the Electrical Installation.

vii) The fuses shall be fitted in Switchfuse, Distribution Boards etc. where they are readily accessible. They shall be so connected as to be in series with circuits they are designed to protect. The current rating of the fuse shall be as shown in Bills of Quantity or contract drawing. All fuses shall be inserted in live conductor only and shall offer class Q1 protection with the fusing factor not exceedingly 1.5 for close protection.

viii) The fuse shall make the circuit dead when the current exceeds 2.4 times the rating of the fuse. They shall be of High Rapture Capacity(HRC) type to **BS 88 or BS 1361** with silver strip as the breaking element and Quartz or Silver Sand filler in a ceramic tube with metal and caps and or/without fixing tags. They shall preferable have fuse blown indicators. The prospective short circuit current of the fuse shall generally be 80 KA for alternating current.
9) Miniature Circuit breakers shall be used for excess current protection in single phase or triple pole, 240V or 415V finals sub-circuits or sub-mains with HRC fuses as backup in the mains switchboards. The MCBs shall easily be opened and closed by hand and open automatically when overloaded. The MCB shall incorporate both thermal and magnetic overload tripping mechanism such that the bi-metal strip shall offer time effect for load tripping, while high speed protection against short circuit is given by magnetic operation. The time response against overload and short circuit currents shall be as specified in particular specifications.

1.27 LIGHTING SWITCHES

i) The lighting switch shall be of tumbler type. For direct current (DC) they shall be of quick break type, while for alternating current they shall be of the “Microgap” type. All switches shall be manufactured to KS04-247: 1988 standard. Where wiring systems is surface wiring, surface switches complete with boxes shall be installed and where conduits are concealed in the fabrics of buildings, flush type of switches shall be installed with boxes recessed.

ii) Single cord ceiling switches, where required, shall be of the type where one pull shall put the switch ON the next pull shall put the switch OFF. The switches shall be fitted with shock absorbing springs in the pull cords. All switches shall be mechanically robust able to withstand the constant operation, and the contacts shall be heavy brass and firm enough to carry the rated circuit current without overheating.

iii) Switches controlling discharge lighting fittings shall be so rated as to operate under likely inductive loads of the fittings. All switches shall be inserted on the live conductors of final sub-circuits only.

iv) The switch boxes shall either be plastic moulded or steel/alloy and the current rate of the switches shall be as described in the drawings or Bill of Quantities. All switches installed external to the building and exposed to the weather shall be of weatherproof type.

v) All switches shall be mounted at a height described in contract drawings and in any case they shall be at least at a height of 1.4m above floor level and in a readily accessible position, at least 220mm from the frames on the unhinged side of the door.

vi) Time delay switches where specified shall be able to operate on an “ON” position for at least two minutes and always on the “OFF” position unless operated. Where more than one flush switch is to be installed under one plate in a multigang assembly and where the live conductors are supplied from more than one phase the plate shall be marked “danger 415 Volts”.

vii) The switch plates shall be either plastic moulded and coloured as specified or metal clad and coloured as specified. The contact parts shall be enclosed in plastic mould insulation material and be of pure copper hard drawn brass.

1.28 SOCKET OUTLETS AND PLUGS

i) Socket outlets and plugs shall be of the types appropriate to the system of wiring employed. They shall be rated 13Amps of 3Pin shuttered, and switched, manufactured to KS04-246: 1987 standard.
ii) For flush pattern the boxes shall either be steel or plastic moulded while for the surface installation the boxes shall be of steel, steel alloy galvanised or enamel painted with corrosive resistant paint, and also plastic moulded type. The number of gangs and type shall be as specified in the drawings.

iii) The socket base shall be of virtuous porcelain or tough insulation material and the contact tubes which must be self-adjusting to the pins shall either be of phosphor bronze or hard drawn brass with sound terminals. The exposed ends of the tubes shall be below the level of the base to prevent them from being touched accidentally.

iv) The shutter mechanism shall be such that the insertion of the earth pin of the plug shall allow the opening of the live and neutral tubes of the socket outlet.

v) All plugs shall be of substantial construction to clamp to the socket outlet tubes firmly. The plug cover shall be of tough rubber plastic non-combustible materials. All plugs shall have 13A cartridge fuse manufactured to BS1363.

vi) The socket outlet plates shall either be plastic mouldered and coloured or metalclad as specified. All outlets shall be installed at height of 300mm from the finished floor level or in special in cases, especially above benches, at 1.4m. All the earth contact tube shall be connected to earth continuity conductors. The insulation of the socket outlet shall be so constructed as to withstand temperatures likely to be encountered during normal operation and at rated current and voltage.

vii) The plug pins shall clearly be identified by “L” for live contact, “N” for neutral contact and “E” for earth contact. Both the plug and socket outlet shall be so constructed that it shall not be possible for any one pin of the plug to be in live contact with socket outlet while the other pin is exposed.

viii) Where two or more points are shown adjacent to each other on the drawings e.g. socket outlet and telephone outlet they shall be lined vertically or horizontally on the centre lines of the units.

1.29 CEILING ROSES

i) All ceiling roses shall either have three terminal connection plate or four terminal connection plates as specified in the contract drawings. All ceiling roses shall have inbuilt barriers between the terminal. They shall be semi-recessed for direct fixing to conduit boxes. They shall be plastic moulded type with shrouded live terminals. All terminals shall be such that conductors and flexible cords can be easily looped in.

ii) Not more than one flexible cord shall be attached to a ceiling rose unless otherwise specified. Each ceiling rose shall be fitted over a biscuit ring of similar colour. All ceiling roses shall have provision for cord grips.

iii) When specified, the ceiling rose shall have an earth terminal which shall be connected to earth continuity conductor of the final sub circuit. The rating of the ceiling rose shall be as specified in the contract drawings and Bills of Quantities. The ceiling rose shall be so wired that no terminal remains alive when the associated switch is off. All the terminals of the ceiling rose shall be of heavy brass, phosphor bronze or any other high conductive corrosive resistant material.
1.30 LAMPHOLDERS

i) Lamp holders shall be of extra heavy gauge skirted type and shall be either be Bayonet Cap (B.C), Edison screw (ES), or Goliath screw (GS) variety, as specified in the drawings.

ii) All the lamp holders shall have heavy brass type electric solid plunge contacts separately sprung by rust proof steel plunger springs. All lamp holders shall be constructed of or shrouded in insulating materials to prevent contact with the live parts. They shall be so designed for quick removal and replacement of lamp and also be able to hold the lamp in firm metal electrical contact to prevent over heating.

iii) B.C type lamp holder shall comply with BS 52. Where lamp holders are supplied by flexible cord, the holders shall have “cord grip” arrangements and in the case of metal shades, earthing screws shall be provided in each of the holders. The screwed cap of the ES and GS holders shall be connected to neutral. When wiring the lamp holders, care must be taken in bearing the flexible cord. The flexible wires must be well twisted together and should not be allowed to splay, as loose single strand may touch either the metal frame of the holder or the opposite terminal. The braiding should be neatly cut away to prevent cotton fibre touching the terminals.

iv) The current rating of the lampholder shall be as specified in the contract drawings or Bills of Quantities. Lamps that are likely to draw more current than the current rating of lamp holder shall not be used or permitted to be connected to the lamp holder. Where not rated the lamp holder shall be assumed to be 5A, 240 Volts, 50Hz variety. BC lamp holders shall be used with tungsten lamps rated upto 150 W while for lamps up to 200W ES lamp holders are suitable and above 200W all lamp holders shall be GS variety.

v) Lamp holders shall either be insulated type of Bakelite, Plastic moulded type, or the brass type with porcelain interior, as specified.

1.31 LIGHTING FITTINGS

i) The electrical contractor shall allow for the provision of handling charges, taking the delivery, safe storage, wiring (including internal wiring), assembling and erection of all lighting fittings shown on the drawings.

ii) All fittings and pendants shall be fixed to the conduit boxes with brass R/11 screws. These shall be in line with metal finish of fittings. The lighting fittings specified are detailed for the purpose of establishing a high standard of finish, but equal and approved alternative fittings shall be accepted. The metallic parts of the fittings shall be bonded to earth continuity conductor.

iii) In case of rectangular shaped ceiling fittings, the extreme ends of the fittings shall be secured to suitable support in addition to the central conduit supply box. Supports shall be provided and fixed by the electrical contractor. Minimum size of internal wiring cables shall be 1.5mm². Where these cables are likely to be exposed to risk of damage by heat generated in the fitting, especially for lamps rated 300W and above, silicone rubber sleeves shall be fitted to the cables.

iv) Where sub- circuit cables are not continued into the lighting fittings terminals, they shall be connected to the fittings wires through Connectors of approved type (see clause on
Connectors.). The insulation of fittings cables employed shall be capable of withstanding the maximum temperature rise of the fittings enclosure.

v) Lighting fittings with chain or tube suspension shall be so mounted that they are in no way supported by the conductors and the whole weight of the fitting shall be borne by the chain.

vi) Lighting fittings should be installed at height indicated in the drawings. Where not indicated these shall be mounted on the ceiling. Fluorescent fittings mounted on combustible material of the ceiling shall be spaced by 25mm minimum from the ceiling by space couplers or dome covers.

vii) It is very essential that the light fitting supplied by the electrical contractor are those specified in the drawings and particular specification for the fittings. However equivalent and approved type shall be accepted unless otherwise specified elsewhere.

viii) The type of lighting fitting supplied shall be as described in the Bill of Quantities and of a particular catalogue number and manufactured by the company indicated. Equal and approved equivalent fittings shall have similar architectural configuration as the one specified, have equal rated lighting lumens output, and of the same colour rendering as those specified and also with similar characteristics as the required fitting, such as dust proof, corrosive proof, etc. In case of fluorescent fittings or discharge fittings, the starting mechanism of the equivalent lighting fittings must also be similar to the one specified. The electrical contractor must indicate the country of origin of all lighting fittings (in the Technical Schedule) which are deemed to be equivalent to those specified. The type of fitting provided shall be such that spares such as chokes, starters, capacitors etc. are available in the local market.

ix) The electrical contractor shall install the lighting fittings oriented as shown in the drawings. The electrical contractor shall not change the orientation without the approval of the Engineer.

x) Each lighting fitting shall be provided with number type and size of lamps as detailed in the drawings. The colour rendering of the lamps supplied shall be as required and specified in drawings or particular specifications.

1.32 STREET SECURITY OUTDOOR LIGHTS & COLUMNS

i) The Street lighting support column shall be at minimum of 300mm depth in the ground on 100mm thick concrete foundations and, the pole up to 200mm shall be surrounded with concrete with brackets that are welded to the column firmly embedded in the concrete. The diameter of the concrete shall be a minimum of 450mm depending on the width of the pole.

ii) After manufacturing and before erection the columns shall be treated with an approved mordant solution, which shall be washed off, and the whole allowed to dry. Thereafter, the column shall be painted with one undercoat and two coats of anti-corrosive gloss paint to an approved colour.

iii) All columns shall be complete with enclosure chambers for installation of switchgear associated with the lighting fitting. The chamber shall be at a minimum height of 1500mm to 2000mm above the ground. The chamber shall also have a vandal proof locking mechanism.
iv) Cable entry position on the column shall be at minimum 75mm above the concrete surrounding. The supply cable shall be drawn through the entry and terminated at an enclosure chamber in the column that is above the ground at height indicated in the drawings. All terminations of the underground cables shall be through cable glands.

v) The column shall be of either aluminium or heavy galvanised steel as specified in contract drawings the height and width shall be as specified in Bills of Quantities or shown on the drawings.

1.33 **COOKER CONTROL UNITS OR OUTLETS**

i) These shall be flush mounted with 13A switched socket outlet and neon-indicators. The cooker control units shall be manufactured to KS O4-247: 1988. The construction of the cooker outlet shall be such that all terminals shall be easily accessed and shall be shrouded to avoid accidental contact.

ii) The current and voltage rating of the cooker outlet shall be equivalent to those of the cooker to be connected and the cooker outlet shall be capable of normal operations at ambient temperatures of 20°C to 45°C.

1.34 **CONNECTORS**

(i) Where specified in Bills of Quantities and drawings, connectors shall be installed for the purpose of joining cables. When not specified, connectors shall be fitted for joining of looped PVC insulated cables with cables in lighting fittings or any other apparatus. The joint so formed shall be both mechanically and electrically sound.

(ii) The connector’s insulation shall be as effective as that of cables forming the joint. Care shall be taken in the choice of connectors in joining conductors of dissimilar metal to avoid corrosion. In particular when joining aluminium and copper conductors, the connectors contacts shall be cadmium alloyed variety to prevent electrolytic corrosion.

(iii) The connector’s screws shall be appropriately shrouded and the whole construction shall comply with KS IEC 60947 Part 1-7 2001 or B.S.196, BS1778 or B.S.4343. The terminals shall be of phosphor Bronze or hard drawn brass complete with screw.

(iv) The connector terminals shall be insulated with PVC or porcelain and be shrouded to prevent accidental contact of live parts.

(v) When the temperatures are not high Rubber insulated connectors may be used.

1.35 **POSITION OF ELECTRICAL PLANT AND APPARATUS**

The routes of cables and approximate positions of switchboards etc. as shown on the drawings shall be assumed to be correct for purpose of tendering but exact positions of all electrical equipment and routes of cables must be agreed on site with the Engineer before any work is carried out.

1.36 **FLEXIBLE CORDS**
(i) Circular sheathed white twin TRS flex to BS: 6500:1989 shall be used for plain pendant fittings up to 100 watts. For all other types of lighting fittings the flexible cord shall be silicone rubber insulated. No polythene insulated flexible cord/cable shall be used in any lighting fitting or other appliance.

(ii) The type of insulation of the flexible cord shall be such as to minimise risk of damage from high temperatures, damp, corrosive situation and mechanical damage. Where flexible cords and cables are likely to be damaged by heat, heat resisting flexible cords shall be used, alternatively conductors shall be sleeved with heat resistant sleeves.

(iii) The contractor shall ensure that exposed unsheathed flexible cables of the flexible cords shall be as short as possible where unavoidable.

(iv) Care shall be taken to ensure the flexible cord does not support lighting fitting exceeding 3 kg. The flexible cord size and rating shall be as described in the Bills of Quantities or contract drawings. Where the cord is not rated it shall be assumed to be capable of carrying 12 Amps.

(v) The colour code for the flexible cord shall be brown for live, Blue for neutral or negative and Green and Yellow for earth.

1.37 **FUSED SPUR**

i) These shall be flush or surface mounted, metal clad or plastic moulded plate of single or double pole switched type, in steel/ plastic moulded box and type and make as specified in the drawings complete with pilot light to KSO4 – 247:1988 standard.

ii) The fused spurs box shall be for connection and supply to permanent Electrical Appliances installed or likely to be installed. The rating of HRC fuse shall be as per contract drawings or Bills of Quantities but shall not exceed 13A. Where the fused spur is to be used to supply a hot water heater system in the bath or kitchen, it shall be positioned out of reach of a person using the bath or sink.

1.38 **LAMPS AND TUBES**

a) The electrical contractor shall supply and fit all lamps, fluorescent tubes, etc., as required for installation.

b) Tungsten filament lamps shall be as manufactured to KSO4 – 112:1978 which is also applicable to General Service’s lamps, which shall be manufactured to KS IEC 60598.

c) Tubular fluorescent lamps shall comply with KSO4 – 464:1998.

d) The lamps and tubes shall be suitable for normal stated voltage and frequency and they shall have power rating as shown in the contract drawings and particular specification. For tubular fluorescent tubes the power factor shall be as specified in particular specifications but not be below 0.8.

e) Colour rendering of fluorescent tubes shall be specified in particular specifications or Bills of Quantities. However where not specified the tubes shall be as assumed to be of “white” variety. Lumen output of the lamps and tubes shall also be specified but where not specified the sub – contractor shall notify the Engineer of the omission.
1.39 WATER HEATERS

a) Unless otherwise specified water heaters shall be of the self-contained type.

b) Where water heater cylinders are made up locally for immersion heaters, the plain cylinder shall be effectively lagged. Adequate thickness of thermal insulation shall be applied to the entire surface of the cylinder.

c) Each water heater shall be supplied by a separate final sub-circuit from the distribution board or consumer or where its rating equal or exceed 3kw, it shall separately metered by the Power Undertaker. In which case the Final sub-circuit shall be from a Double pole switchfuse (or Double Pole MCB) in the Meterboard. The wiring shall be complete from the distribution board, meterboard, or consumer unit to water heater switch without introduction of a plug and socket outlet. An approved heat resistant cable of butyl rubber insulated as CMA reference 610 butyl of voltage rating 600/1000 volts shall then connect the water heater switch to the immersion heater terminals.

d) Small domestic water heaters in kitchen will be controlled by means of a switch fused spur with neon indicator and labelled “water heater”. The switch shall comply with BS 1363. The electrical supply will be brought out to the appliance, through a round box with a dome lid situated close to the point of connection of the appliance. The connection will be in M.I.C.C. cable terminated in appropriate glands designed for use in conjunction with this class of cable. The conductors shall be insulated with porcelain beads or appropriate heat resistance sleeves from the gland to the point of connection at the water heater.

e) All water heater switches shall be placed out of reach from a person using the bath or sink. The water heater shall be properly earthed from an earth terminal on the apparatus plate to the general earth connection or earth continuity conductor. The pipe work of the hot water systems should not be relied upon as an earth continuity conductor, but shall be bonded.

f) The final sub-circuit of the water heater shall be protected by HRC fuse or MCB of appropriate current rating as shown in contract drawings. The water heater switch shall be a micro gap double pole switch labelled “WATER HEATER”.

1.40 PROSPECTIVE CURRENTS AND DISCRIMINATION

Prospective Currents

Prospective current of the installation or Short Circuit Current Fault level is the RMS value of the alternating component of an Alternating Current (AC) that would flow in a circuit due to applied voltage, when a link is placed between the live and neutral conductors at any position of the circuit.

Thus when the live and the neutral conductor of a final sub-circuit is shorted through a link and voltage applied the RMS value of the short circuit current which shall flow shall be short circuit Current Fault level or the prospective current level of the final sub-circuit at the position of the shorted point.
The value of the current is limited by the impedance of Supply Transformer, winding impedance, cable impedance, impedance of joints and equipment between the transformer and the fault position.

Generally the short Circuit Fault level at the Final sub-circuit is not expected to be higher than 3KA while at the Main Distribution Board the fault level may be as high or approximately 14KA. The Engineering design of the installation is such that all excess current protective device specified in Bills of Quantities and contract drawings are of specified prospective fault current level and any change in the installation with different protective devices introduced by the contractor could affect the design.

The contractor shall notify the Engineer of any changes he is likely to incorporate in the installation of protective device for approval before installation especially if the devices he intends to install are of different make from those specified. The installed fuses and MCBS must conform to the specified prospective fault current levels.

**Discrimination**

The installation shall be considered to offer effective discrimination when only the faulty final sub-circuit or a particular faulty apparatus is isolated.

Discrimination between two or more protective devices in series shall be proved to occur when, on the incidence of a short circuit or an over-current, only the device intended to operate does so.

Where HRC fuses are used as protective device in conjunction with MCBS the fuses shall provide back up protection to cut off high prospective currents rapidly thus reducing damage to the installation. The MCB shall offer rapid interruption of low prospective short circuit current in the Sub-main and Final sub-circuits. In general discrimination between two devices shall occur when pre-arching \(1^2t\) of the major device, say HRC fuse-device of high current rating is greater than the total operational \(1^2t\) of the minor device of lower current rating, say an MCB, at its designed prospective short circuit fault level current \((I)\).

The electrical contractor before installing the prospective devices shall ensure that the characteristics and specifications of such devices comply with the above criteria as well as the specifications drawn in particular specification for fuses and MCBS. \((I^2)\) shall be the square of Ampere RMS value of prospective short circuit fault level current and \(t\) the time period in seconds.

1.41 **Residual Current Circuit Breakers or Earth Leakage Circuit Breakers**

(i) The Residual Current Circuit Breakers or Earth Leakage Circuit Breakers shall be installed whenever indicated on the drawings and required by the regulation. However wherever a socket outlet is placed within 2 metres from a sink irrespective of the type of building, an Earth Leakage Circuit Breaker shall be installed to protect the ring main where the socket outlet forms part.

(ii) The current operated Earth leakage circuit breaker shall be installed if the product of its operating current in amperes and the earth loop impedance in ohms exceed 40. The operating current of the current operated Earth leakage circuit breaker in this
specification shall not be more than 30mA and shall be of high sensitivity such that they shall trip in less than 30ms for a leakage current of 30mA (equal to the operating current). They shall be of the type not requiring a mains supply to operate the trip mechanism under fault conditions. The current operated Earth Leakage Circuit Breaker shall also be able to trip automatically when the neutral of the supply is absent, thus ensuring that there is no likely danger of a live-to-earth fault being present on the neutral side of the load. The Earth Leakage Circuit Breaker shall incorporate a test button and shall also protect the installation against excess current and short circuit fault in addition to earth leakage faults.

iii) Where the installation involves current operated earth leakage circuit breaker the consumer earthing terminal shall be connected to a suitable earth electrode.

iv) Where voltage operated earth leakage circuit breaker is specified for single phase installation the operating coil of the circuit shall be connected between the consumer earth terminal and an earth electrode through the earth lead. The earth electrode used with any voltage operated earth leakage circuit breaker shall be placed outside the resistance area of any parallel earth which may exist. The earthing lead between the operating coil and the earth electrode shall be effectively insulated. The Voltage Operated Earth Leakage Circuit Breaker shall incorporate means of testing through a finger operated test button.

v) For three phase voltage Earth Leakage Circuit Breaker, connection to consumer earth terminal is not necessary. The Earth Leakage Circuit Breaker may be arranged to work in place of MCCB or MCB, or operate as a back up protection. The voltage operated Earth Leakage Circuit Breaker shall be necessary when the earth loop impedance exceeds the values applicable to fuses or MCBs. For example, for fuse of current Rate 100A the measured earth loop impedance is required to be 0.8Ohms. Value above that will necessitate installation of voltage operated Earth Leakage Circuit Breaker or improvement of earthing installation.

1.42 METER BOXES (METERBOARDS) AND CABLE-LOOP-IN BOXES

i) The electrical contractor shall supply and install standard single or Dual Tariff Meter Box or any other specified Meterboard where called on in contract Drawings. He shall also provide the necessary conduits for Kenya Power and Lighting Service Line cable entry.

ii) Where more than two meters are to be installed in a Meterboard or Main Switchboard with provision for meters, the electrical contractor shall ensure adequate provision is provided for installation of both KPLC meters and accompanying Cut-outs. The meterboard shall be of dimensions approved by the Engineer.

iii) All meterboards shall either be constructed of galvanized steel sheet or of zinc powder coated and painted steel sheet to Engineers approval.

iv) Cable loop in – Box shall be to MOW drawing No. SFB (69) 7006D unless otherwise specified. They shall be fitted with Lucy Type connecting Blocks or equivalent. Appropriate current protecting device such as Double pole MCBs, HRC fuses etc. where specified in the drawing shall enclosed in the Cable loop. The Cable-Loop-in Box cover shall be complete with neoprene gasket or equivalent.
1.43 TELEPHONE OUTLET

i) The electrical contractor shall install conduit for telephone wiring as shown in the drawings. The minimum conduit size shall be 25mm diameter PVC or steel conduit as specified.

ii) Draw wires shall be left in all the conduits for telephone installation, in case telephone wiring shall be required to be installed later. The conduits shall be terminated to suitable Telephone outlet boxes of steel/alloy or Plastic moulded.

iii) Where telephone lines are to be installed along trunking they shall be installed in a separate channel or compartment of the trunking to ensure segregation from other cables of high voltage supply.

iv) Outlet plates shall be as specified in contract Drawing and Bills of Quantities and in any case shall be of the type complying to KS 1588-3:2001.

v) Where telephone points are to be wired the cables used shall conform to KS 1588-3:2001. The cables so installed shall be terminated in appropriate termination Block or Discase.

1.44 MINERAL INSULATED COPPER SHEATHED CABLES (MICSC)

(i) Mineral insulated copper sheathed cables, where required especially in flame proof installation, shall be of those manufactured in accordance with B.S.3207 by an approved manufacturer. Where installed in corrosive situations, and for purposes other than for flame proof installation, they shall be P.V.C. sheathed in addition. The cables shall be of 440/600V Grade.

(ii) The cables sizes shall be as specified in contract drawings. Where installed on walls or any non-conductive surface the cables shall be fixed on the surface by copper saddles.

(iii) Where bare MICS cables are fixed to cable tray, the fixing shall be by means of bare copper saddles where the cable tray is of PVC material. If the cable tray is of steel galvanized or steelwork, then the MICS cable should have extruded PVC cover or the steel tray must be painted.

(iv) Where PVC covered MICS cables are fixed direct to the structure of the building, the fixing shall be by means of PVC covered copper saddles and brass bolts and nuts.

(v) MICS cables must be protected from mechanical damage by covering them when drawing them in short lengths of PVC conduit. The cable end shall be sealed by the use of metal screw-pot type seal. The cable shall first be prepared by cutting away a suitable length of copper tube and removing magnesium oxide inside, leaving the bare copper conductors to protrude. The metal pot shall then be screwed on the copper tubing, cutting its own thread. The pot shall be sealed with plastic compound well rammed in, and a sub-assembly comprising a fibre cap and neoprene insulating sleeves, shall then be threaded over the conductors and cramped into position with a special tool.
(vi) The cables where required shall enter into metal or PVC switchboxes, Distribution Boxes etc. by special glands which shall screwed into boxes and hold the sealed ends of the cables in a secure grip. In special conditions flameproof glands may be used.

(vii) In areas where flameproof insulation shall be specified the glands shall be of a flameproof type. For maximum operating temperature of upto 150º (302ºF) the seal shall comprise of a brass pot, a silicone bonded glass disc and fluorinated ethylene propylene(FEP) or elastic insulating sleeves and porcelain wedges.

(viii) The contractor shall provide the Engineer all the tools necessary for termination MICS cables after the installation.

(ix) Ferrous plates or structures through which the cables are required to pass shall be slotted and brass glands and sockets shall be used.

(x) Where single core MICS cables are to be used all necessary precautions shall be taken to prevent hysteretic and eddy currents.

(xi) After installation within 24 hours the whole installation of MICS cable shall be tested and commissioned.

1.45 AS INSTALLED DRAWINGS.

The installation shall not be considered complete until test certificate and “As installed” drawings have been submitted and approved by the Engineer.

1.46 TESTING AND COMMISSIONING OF ELECTRICAL INSTALLATION ON SITE

The electrical contractor shall conduct, during and, at the completion of the installation and if required again at the expiration of the maintenance period, tests in accordance with the relevant section of IEE regulations and also to rule 3 of the Electrical Power Act, for additional test not covered by the regulations, and the Electricity Supply Authority by-laws.

The results of the tests shall be recorded on a test and commissioning certificate supplied by the Engineer or his representative. Two copies of each certificate shall be provided.

Additionally, in the case of underground cables, test shall be carried out to establish continuity, phase sequence and high voltage tests if required by the Engineer.

a) Tests shall be carried out to prove that all fuse and single pole switches are installed in the “Live” Conductor.

b) Tests shall be carried out to prove that all socket outlets and switched socket outlets are connected to the “Live “ conductor in the terminal marked as such and that each Earth pin is effectively bonded to the earth continuity system.

c) Tests shall be carried out to verify the continuity of all conductors of each “Ring” circuit.
d) Phase tests shall be carried out on completion of the installation to ensure that correct phase sequence is maintained throughout the installation. Triplicate copies of the results of the above tests shall be provided within 14 days of the witnessed tests and contractor will be required to issue to the Engineer the requisite certificate upon completion as required by the regulations referred above. In case of underground cables, tests shall be carried to establish the continuity, phase sequence and high voltage tests.

e) Inspection shall be carried out to ensure;
   i) No terminal in the Ceiling Rose is “LIVE” when the corresponding switch for that Ceiling Rose is in off position
   ii) All conduit termination, conduit boxes, consumer unit, Distribution Boards, Adaptable boxes etc., shall not have rough edges and are bushed.
   iii) All fixed metal works close to Electrical installation are bonded to earth continuity conductor

f) Other tests may be conducted to test whether the arrangement of protective devices can afford Discrimination i.e., a fault in the furthest power point or lighting point does not blow or trip Fuses or MCBs respectively in the Meter Board, as an example, but blows or trips those that are in the consumer unit that are protecting the respective Final sub-circuits with the faults.

g) Other tests shall include;
   i) Installation Resistance Tests to various circuits and conductors and apparatus,
   ii) Earth-continuity conductor impedance tests,
   iii) Earth loop impedance tests,
   iv) Earth Electrode resistance tests.

h) Any apparent fault, defects or omission or faulty Workmanship, incorrectly positioned or installed parts of the installation found by such inspections or tests shall be rectified by the contractor at his own expense.

i) The electrical contractor shall provide accurate instruments and apparatus and all labour required to carry out the tests. The instruments and apparatus shall be made available to the services Engineer to enable him to carry out such tests as he may require. The contractor shall generally attend on other contractors employed on the project and carry out such electrical tests as may be necessary.

The Engineer and the contractor shall also participate in testing and commissioning of all other equipment plant and apparatus forming part of the works, in particular insulation tests, before connecting any power or other supply and setting to works such plant or apparatus.

Where such equipment etc. forms part of or is connected to a system whether primarily of an electric nature or otherwise (e.g. Air conditioning systems) the electrical contractor shall attend on and assist in balancing regulating, testing, and commissioning the systems to the service Engineer’s approval.
Space Factor

Ensure not many Electrical cables are drawn in the same conduit and a space factor of 40% is maintained.

Illumination Level

The illumination level shall be as per design specification. A Lux meter may be used to test the illumination level of various rooms in the building.

Manuals

Obtain from the contractor all the maintenance manuals as required by the specifications.

Earthing

Inspect the Earthing Chamber to ensure the earth lead is enclosed in conduit up to the point of connection to the Earth rod Clamp. Ensure the earth lead cable termination at the earth rod clamp is be corrosive resistant.

Radial Circuits

Inspect and ensure that for all Appliances, Equipment, Apparatus etc that are required to be supplied by radial circuits directly from Distribution boards, Consumer Units etc., without the circuit supplying any other equipment, this requirement is achieved.

*Underground Cables

All Armoured Cable installation shall be tested in accordance with GES No. 2 and the result recorded.

Non-metallic conduits shall be of high impact quality rigid PVC conforming to B.S 4607 or KS04-179: 1988 and IEE

B.S. 31/1940 BS 4607 part 1, 1970 or to KS 04-179 1979 Part 1

➢ PVC insulated cables and Flexible Cords Ks 04-192:1988 or BS 6004

➢ PVC insulated Armoured Cables KS 04-194: 1990 or BS 6346

➢ Armouring of electrical cables KS 04-290: 1987


Where metal conduits and fittings are to be used they shall be of heavy gauge annealed mild steel Class “B” welded or solid drawn to standard specification KS-04-180: 1985 or BS 1387

All boxes shall conform to KS04-668: 1986

The switchboard shall be manufactured in accordance with KS04-226 (or BS 162).

The busbars, busbar connections and bare conductors forming part of the equipment of the switchboard shall be of current ratings as specified in the drawings, they shall also
be able to withstand temperatures limits encountered during the normal operations of the switchboard and comply with BS. 159

All fused switchgear and isolators shall conform to the requirements of KS04-226 PART 1:1985, all contacts are to be fully shrouded and are to have a breaking capacity on manual operations as required by KS-04-182: 1980.

All switches shall be manufactured to KS04-247: 1988 standard.

Socket outlets and plugs shall be of the types appropriate to the system of wiring employed. They shall be rated 13Amps of 3Pin shuttered, and switched, manufactured to KS04-246: 1987 standard 13A cartridge fuse manufactured to BS1363.

B.C type lamp holder shall comply with BS 52

Such Distribution board shall be complete with HRC fuses to B.586 1952 category 440 volts A.C.5

The cooker control units shall be manufactured to KS O4-247: 1988

The connector’s screws shall be appropriately shrouded and the whole construction, shall comply with KS IEC 60947 Part 1-7 2001 or B.S.196, BS1778 or B.S.4343.

These shall be flush or surface mounted, metal clad or plastic moulded plate of single or double pole switched type, in steel/ plastic moulded box and type and make as specified in the drawings complete with pilot light to KSO4 –247:1988 standard.

Tungsten filament lamps shall be as manufactured to KSO4 -112:1978 which is also applicable to General Services lamps, KS IEC 60598.


Small domestic water heaters in kitchen will be controlled by means of a switch fused spur with neon indicator and labelled” water heater”. The switch shall complying with BS 1363

All fused switchgear and isolators shall conform to the requirements of KS IEC 60439 Part 1-5. They shall be of High Rapture Capacity(HRC) type to BS 88 or BS 1361 with silver strip as the breaking element and

Outlet plates shall be as specified in contract Drawing and Bills of Quantities and in any case shall be of the type complying to KS 1588-3:2001.

Where telephone points are to be wired the cables used shall conform to KS 1588-3:2001. The cables so installed shall be terminated in appropriate termination Block or Discase.

Mineral insulated copper sheathed cables, where required especially in flame proof installation, shall be of those manufactured in accordance with B.S.3207 by an approved

The switch shall comply with BS 1363. The electrical supply will be brought
PART B

PARTICULAR SPECIFICATIONS

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2 PART B: PARTICULAR SPECIFICATIONS AND CONDITIONS

2.1 Location of Site

The site of the proposed project shall be situated at Kenyatta National Hospital, Off Ngong Road, Nairobi.

2.2 Description of Project

The project objective is to establish the East Africa Kidney Institute Project, which shall be a centre of excellence for kidney related diseases in the East Africa Region. The project shall entail development of a complex to accommodate wards, theatres, dialysis units, administration offices, data centre and plant rooms. The complex will entail a Basement, Ground, First, Second, Third and Fourth Floors.

2.3 Commencement of Works

The Sub-Contractor in submitting his tender shall be deemed to have included for Commencing any necessary work on site at such a time as will comply with the Main Contractor’s programme.

2.4 Scope of Works

The Sub-Contract Works shall comprise the supply, delivery, erection, testing, commissioning and setting to work of the Electrical Engineering Services as detailed in this Specification and the accompanying Contract Drawings.

The Sub-Contractor shall include for all apparatus and appliances not particularly called for in this Specification or on the Sub-Contract Drawings but which are necessary for the completion and satisfactory functioning of the Sub-Contract Works. No claims for extra payments shall be entertained from the Sub-Contractor due to his failure to adhere to the above requirements.

It is deemed that if in the opinion of the Sub-Contractor at the time of tendering, there existed a discrepancy between the Specification and the Contract Drawings, that the Sub-Contractor clarified this difference with the Engineer before tendering.

The work to be undertaken under this Sub-Contract shall comprise but not restricted to the following: -

(a) Liason with KPLC for power supply.

(b) Supply and installation of New Consumer M.V. Gear.

(c) Supply and Installation of New Transformers.

(d) Supply and Installation of a New Main L.V. Switchboard and Sub-switchboards.

(e) Supply and Installation of a Power Factor Correction Bank.

(f) Supply and Installation of various new sub-switchboards.

(g) Termination of supplies from standby generators. Generators shall be supplied by others.
(h) Supply & Installation of Lighting Fixtures.

(i) Installation of Power Distribution Cables

(j) Supply and installation of small power.

(k) Power supply to medical and other Mechanical services equipment’s.

(l) Installation of lightning protection systems and bonding of the same to the electrical earthing as appropriate.

(m) Small power wiring in new compartmentalised trunking.

(n) Supply & Installation of the External/Security, Car Park and Amenity Lighting within the complex and access roads.

(o) Supply & Installation of cable ducts, cable trays and trunking.

2.5 Ordering of Materials

The Sub-Contractor shall order materials from the quantities taken from his own approved working drawings and not from the quantities shown on the Contract Drawings or in the Specification.

2.6 Builder's Work Requirements

The structural and other provisions allowed for are indicated on the Contract Drawings. If the Tenderer requires any other provisions, he shall mark them in a contrasting colour and submit them as part of his tender.

2.7 Statement of Compliance

The Tenderer shall provide as an integral part of his bid, a statement of compliance in which he shall clearly declare any items of the Specification to which his offer does not comply and the alternative which is included in the offer.

2.8 Storage of Materials

The Sub-Contractor shall be liable for the cost of any storage and accommodation provided especially for their use.

If the Sub-Contractor does not wish to use the storage space provided by the Employer, he may, at the Engineer's discretion, be allowed to store these in his premises. In this case, the Sub-Contractor shall be required to provide a Security Bond specifically covering those materials intended for use on the Contract Works.

2.9 Labour Camps

Labour camps will not be permitted on the site and the Sub-Contractor shall allow for all transport and other charges in moving labour to and from the site.
3 PART C: MAIN POWER CENTRE - M.V. SWITCHGEAR & TRANSFORMERS

3.1 Scope of Works

This section of the Specification covers the supply, installation, testing, commissioning and hand over of the medium voltage switchgear with vacuum or SF₆ gas-filled breakers including installation of medium voltage XLPE cables, protection relays etc. and 2No. 1.6MVA ground-mounted transformers as indicated in the drawings and specified in this document. KPLC shall supply and install their HT Switchgear and metering equipment.

3.2 The M.V. Switchgear

The M.V. switchgear (11kV) on the consumer’s side shall be of 1No., panel, SF₆ insulated, indoor/outdoor, non-isolatable, extensible pattern, metal clad ABB, Siemens or Schneider switchboard (or approved equivalent), suitable for use on an 11kV, 3-phase, 3-wire, 50Hz, earthed neutral system with an impulse withstand level of 95kV and a fault rating of 21kA for 3 seconds. The panel shall be equipped with M.V. cable boxes suitable for accepting cables from below and 500A bus bars and shall have circuit breakers as transformer feeder. The Sub-Contractor shall liaise fully with KPLC in the termination of their service line.

The panel shall be equipped with M.V. cable boxes suitable for accepting cables from below and 400A bus-bars and circuit breaker as the main incomer (ABB/Schneider or Siemens Type CE6 – T5 or approved equivalent).

The Sub-Contractor shall also allow for 2No Indoor heat shrink termination kits suitable for 95mm² 3 core 11kV XLPE cables. The Sub-Contractor’s attention is drawn to the Schematic for HV. Switchgear, Drawing No. EP_003 and EP_004.1

The 11kV switchgear shall be as Yorkshire switchgear, ABB/Schneider/Siemens or equal and approved. It shall be metal clad to British Standards and IEC 298 No.3102 edition 1981. The panel shall have separate compartments for the busbars, cable box, fixed isolator contacts a spare chamber currents and or voltage transformers and the instrument panel.

The equipment to be supplied shall meet the following requirements:-

- Ensure service continuity and operating staff safety.
- Allow easy and minimum maintenance
- Be easily adaptable to future arrangement and extensions.

The required switchgear shall comply with the latest of IEC standards. As far as the characteristic of design and construction, ratings and testing procedures are concerned, switchgear shall meet the following IEC recommendations:-

- Switchgear assemblies IEC 298 and 694
- Circuit breakers IEC 56
- Current transformers IEC 185
- Voltage transformers IEC 186
- relays IEC 255
- LV wires IEC 695

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The cubicle shall be fitted with a circuit label of a suitable size which shall clearly indicate the function of the panel. All metal parts shall be suitably protected against corrosion. A final coat of heavy duty finishing paint shall cover the whole of the external part of the switchboard.

3.3 Medium Voltage Circuit Breakers and switches

The circuit breaker shall be of the Sulphur Hexa Fluoride (SF6) type. It shall not involve any special maintenance and shall have a high electrical endurance. The circuit breaker shall be of the mechanical and electrical trip - free type. Built-in interlocks shall be incorporated to prevent any mishandling and provision for key locking and padlocking shall be made. It shall be impossible to:

- close the circuit breaker unless it is locked in service or test position.

The enclosures of poles shall be sealed for life type, as defined in IEC 56. The permissible rate of leakage shall be less than 0.1% per year. The life expectancy shall be at least 20 years. The poles will be assembled decked in factory by the method which is described in IEC document (accumulation leakage measurement). The long mechanical and electrical life make it unnecessary to open the enclosures, in order to renew the live part.

The design of the circuit breaker shall enable checking the condition of arcing contacts without opening the breaker poles.

The enclosures shall be in insulating material to avoid having stress in the current bushing in the circuit-breaker. The mechanical life shall be 10,000 openings. The Tenderer shall give the relationship giving the number of breaks with the current.

The circuit breaker shall be covered by a test certificate issued by a recognised testing authority, member of STL (Short circuit Testing Liaison) recognized by International Agencies. The circuit breakers shall be equipped with an electrical spring stored energy operating mechanism, including at least:

- 1 electrical motor, recharging the mechanism as soon as the breaker is closed or opened.
- 1 anti-pumping relay to prevent the closing coil being fed continuously.

In addition, the circuit breaker shall be fitted with an operation counter. On the front plate of the circuit breaker indication and control devices shall be provided as follows:

- Mechanical indication of the position of the circuit breaker, positively driven in both open and closed positions.
- Mechanical indication of the state of the motor charged spring; this shall clearly show whether the spring is charged or not.
- Local manual spring release.
- Emergency hand operated local spring charging device.
Provision shall be made for local manual tripping and closing of the breaker and at the front of the cubicle a plate shall bear all the indicating and control devices necessary to carry out normal service operations.

The circuit breaker shall be equipped with suitable number of auxiliary switches. They shall be positively driven in both positions and be mounted in such a way as to facilitate maintenance and inspection. The equipment which constitutes the contact surfaces shall be treated against corrosion.

In order to prevent any access to the live fixed contacts, a set of two safety metallic shutters shall be positively driven by the circuit breaker during withdrawal i.e. without any spring or any effect of gravitation. These shutters shall cover each three phase group of fixed contacts on the busbar and circuit side, when the circuit breaker is removed. Padlocking facilities shall enable locking of the two shutters. The two shutters shall be labelled with suitable warning symbols.

The design of the switchgear shall not facilitate manual handling of the shutters by the operating staff even if the circuit-breaker is removed. However, in order to perform primary injection of the cable tests, access to the cables fixed contacts fixed shall be possible through a special truck (see next paragraph).

Preferably, one shall be designed to incorporate two functions, earthing and testing.

3.4 Testing facilities

The circuit breaker shall have test positions between the connected and disconnected positions. When in the test position, the circuit breaker shall be disconnected from the circuit and busbar contacts but still be positioned inside the panel. Low Voltage plug shall remain connected in order to operate the circuit breaker electrically.

On the other hand, in order to carry out primary injection or insulation cable testing, provision shall be made for easy access to the cable without removing the shutter manually, preferably in the shape of a removable testing truck which shall incorporate an earthing switch to secure testing procedure.

These tests shall be performed only with the testing truck with the connecting conductor in the relevant position. This truck shall be able to be inserted in the place of the circuit-breaker. A door located on the front plate of the truck shall provide access to the cable contacts. This door shall be suitably interlocked to prevent the door being opened when the cable earth-switch located on the truck is in open position. A set of three lamps fitted on the truck shall indicate whether the cables are energized or not.

3.5 Technical Specifications and Ratings

<table>
<thead>
<tr>
<th>Specification</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>System voltage</td>
<td>11kV</td>
</tr>
<tr>
<td>Insulation level</td>
<td>13.8kV</td>
</tr>
<tr>
<td>Impulse level</td>
<td>95kV</td>
</tr>
<tr>
<td>Circuit Breaker Rating</td>
<td>200A</td>
</tr>
<tr>
<td>Busbar rating</td>
<td>400A</td>
</tr>
</tbody>
</table>
Symmetrical Breaking Current - 20kA
Making Current - 50kA peak
3 second short time current - 20A
IP rating - IP54

No. of panels
(a) Incomer Feeder - circuit breaker rated at 200 amps.
(b) Spare chamber.

Trip coil rating 30 volts DC
Auxiliary supplies 240 volts 50hz single phase 30volts Dc
Protection IDMT over current/earth fault relay for incoming and outgoing feeders.
Meters: Ammeter, Voltmeter + selector switches + CT's and fuses for incoming and ammeters + s/switch + CT for outgoing.
Potential Transformer: Primary volts to supply Class B BSS 3941.
Secondary volts: 110V burden 100VA
Current Transformer 2 CT's in red phase and blue phase.
Heat Each panel is to be fitted with anti-condensation heater with ON/OFF switch operating from 240V AC supply.

Drawing and Manual
Duplicate set comprising of overall dimensions drawing, panel layout drawings, wiring and schematic diagrams together with two copies of operating and maintenance manuals will be submitted for approval.

Design Manufacture and Routine Tests:
Transparent (Meninx) copy of each approved final drawings and diagrams together with four copies of operating and maintenance manual shall be supplied before completion of the contract.
The equipment shall be designed, manufactured and tested in accordance with the following British Standard Specifications.

3.6 Labelling

The individual units of the composite 11kV switch panel and transformer shall be labelled with black traffolite labels bearing engraved white letters and securely fixed to the front of each item of equipment.

3.7 Tests and Inspection

The Engineer shall be given the facility to inspect the switchboard at the manufacturer's works during the course of erection and when all parts are open for examination.

The Engineer shall be given adequate notice before final testing of the switchboard before despatch and may appoint a representative to witness these tests.

The tests shall include the following:

(i) Millivolt drop test and power frequency test both in accordance with BS.2631-1955.

(ii) The insulation resistance of the complete switchboard shall be measured.

(iii) The circuit breaker shall be operated manually or electrically 50 times to the satisfaction of the Engineer or his representative. Where the circuit breaker is designed for electrical operation at least 10 of these tests shall be made with 80% normal voltage applied to the closing coil and 50% of the normal voltage applied to the trip coil in accordance with BS. 116 - 1952. During this test the trip free feature shall be demonstrated.

The manufacturer shall supply all equipment necessary for the tests to be carried out and shall submit to the Engineer three copies of the routine test certificates together with three copies of the A.S.T.A type certificates for all parts of the switchboard.

3.8 Special Tropical Finish

The following requirements must be noted and the Engineer shall inspect all plant to ensure that it complies with this specification.
(a) Switchgear, busbar chambers, etc. shall be totally enclosed and have vermin proof cases.

(b) All gaskets shall be neoprene or similar material.

(c) All LV interconnections shall be PVC insulated. Rubber insulation shall not be used.

(d) All steelwork shall be treated with a phosphoric base etching primer containing a resin bond and finished with two coats of paint.

(e) The interiors of all items of plant which are not oil, compound or otherwise insulated and all exposed current carrying metal work except contact faces shall be sprayed with an approved type of bakelite varnish.

3.9 Transformer

The transformer shall be as Lindley Transformers from Yorkshire or equal and approved switchgear oil immersed naturally cooled type “ONAN” and shall have continuous rating at the altitude of 1750m, and without exceeding temperature rise limits as specified in B. S. 171: 1970 and IEC publication 76.

The transformer shall be of free breathing type with plain breathing device and following specifications:

Rating : 2 No. 1600 kVA
Phases : 3 phase
Frequency : 50Hz
M. V. Volts : 11kV
Impulse kV peak : 75
Power Frequency K.V. VMS : 28
M. V. Tappings : 2.5 and 5%
Tap Selection : By externally operated off circuit switch.
L. V. Volts – No Load : 433 Volts
MV/LV Connection : Delta/Star
B. S. Vector Group : DYN 11
Temperature Rise : 55º
Type : Ground Mounted – indoor.

The transformer shall be supplied complete with rating and connection plate, oil level indicator, thermometer pocket, earthing lugs, drain/sampler valve and plug, lifting lugs, jacking lugs, with base skids drilled for roller axles.

3 pole cable sealing box with wiping gland suitable for 1 – 3 core up to 120mm² XLPE insulated copper cable.

The transformer shall be oil immersed core type and shall be manufactured and tested as per IEC 76.

The transformer shall be either free breathing type or hermetically sealed (where specifically requested). No drain plug shall be fitted unless specifically requested in Appendix B. Oil gauge shall be provided on all transformers. The oil gauge shall be
clearly readable by an operator standing at ground level a distance of 5 meters away from
the transformer mounting.

Free breathing transformers shall be provided with a conservator, an isolating valve and a
derhydrating breather. The conservator shall be in such a position as not to obstruct the
electrical connections to the transformer and oil gauge provided at one end of the
conservator marked with oil levels.

The transformer shall be provided with a round, dial type winding temperature indicator
equipped with a maximum temperature indicator and positioned on the top cover. The
dial of the temperature indicator shall have a scale ranging from 30°C to 150°C, preferably
uniformly divided.

The complete transformer shall be painted to protect against corrosion, and the final
colour of the exterior surface shall be Dark Admiralty Grey colour No. 632 as per BS
381C. The inside of the tank shall be coated with oil resisting varnish or paint so that
oil cannot come into contact with tank or metal at any point.

The transformer tank shall be constructed of mild steel plates fabricated by pressing or
rolling.

The transformer tank shall be sealed by welding and be fitted with earth terminals. The
transformer top flange (lib) dimensions shall be clearly indicated on the tender drawings
and shall not be less than 7 cm.

The cores shall be constructed of high quality low loss grain oriented electrical steel
laminations. The design shall ensure no hot sections due to overfluxing or circulating
currents. The flux density at any point shall not exceed 1.65 tesla.

The cores shall be clamped effectively with wooden cross-arms and be fitted with core
lifting lugs.

The windings shall be of electrolytic copper capable of sustaining short circuit forces on
the transformer. Where Aluminium materials are to be used, the supplier shall state the
variation.

The primary windings shall be of full coil as opposed to segmented winding and the
secondary windings shall be coil or foil.

The high voltage winding shall have tappings at ± 2 X 2.5% operated by an off-circuit
switch with marked position indicators. Tapping details shall be included on the
transformer name plate.

The switch shall be located at the transformer cover with sufficient electrical clearance
and Switch position No. 1 shall correspond to highest voltage on the HV side, and No. 5
shall correspond to the lowest on the MV side.

The make contacts of the tap changer shall be robust and of sufficient surface area.

The star point of the low voltage winding for the three-phase transformer shall be brought
out to a neutral bushing.

The three phase transformer shall be wound to IEC vector reference Dyn11.
Outdoor brown and glazed weatherproof bushings, provided with screwed stem of diameter 12 mm and nuts or with clamp for conductor from 7.8 mm to 18.2 mm diameter shall be mounted on the tank cover. The bushings shall be constructed, arranged and fitted in such a manner as to be changed without opening the transformer. The high voltage bushing shall be fitted with adjustable double-gap arcing horns set at 2 X 25mm gaps.

The minimum external electrical clearances and minimum creepage distance of the bushing shall be as indicated below:

<table>
<thead>
<tr>
<th>Nominal System Voltage between Phases</th>
<th>11kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum clearances between phase to earth</td>
<td>mm 300</td>
</tr>
<tr>
<td>Minimum Clearances between phases</td>
<td>mm 250</td>
</tr>
<tr>
<td>Creepage distance</td>
<td>mm 280</td>
</tr>
</tbody>
</table>

The ground mounted transformer shall be fitted with cable boxes. The HV and LV cable boxes shall be mounted on opposite sides of the tank by bolting, arranged for cables entering vertically from below. Each bushings shall have a separate insulator moulding.

The HV cable box shall be suitable for terminating three core cables up to 300 mm2 XLPE cable. The LV cable box shall be suitable for terminating up to 24No. Single core PVC cables of 630 mm2 on a stud of 12 mm diameter.

Cooling of the transformer shall be by natural circulation of oil and natural circulation of air (ONAN).

The transformer shall be filled with oil as per IEC 296.

Each transformer shall be provided with a metal name plate giving the required particulars. In addition, the name plate shall include load and no load losses for the highest, lowest and nominal tap changer positions, temperature class of insulation, connection diagram and the inscription.

The transformer shall be capable of carrying its full normal rated current continuously under the tropical conditions stated, and at any tappings without the temperature rise in the hottest region exceeding 60°C and 65°C in oil and winding respectively.

The transformer shall be capable of sustaining a three-phase symmetrical short circuit on the low voltage side with power maintained on the high voltage side without damage or distress for 2 seconds. The design distribution fault level for 11 kV is 25 kA.

The impedance voltage measured at the normal tap shall not exceed the value indicated in the following table.

<table>
<thead>
<tr>
<th>RATING (kVA)</th>
<th>PHASE</th>
<th>SYSTEM VOLTAGE (kV)</th>
<th>% IMPEDANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>630</td>
<td>3</td>
<td>11</td>
<td>5.0</td>
</tr>
<tr>
<td>1000</td>
<td>3</td>
<td>11</td>
<td>5.0</td>
</tr>
<tr>
<td>1600</td>
<td>3</td>
<td>11</td>
<td>6.0</td>
</tr>
</tbody>
</table>
The transformer protection shall include winding temperature alarm and trip as well as oil level alarm and trip.

The breathing type transformers shall be fitted with a glass breather containing silica gel. The silica gel shall be changed before turning from blue to pink to protect the transformer core against the ingress of moisture.
3.10 **H.T Cables**

High tension cables shall be X.L.P.E. insulated [95mm²] with copper conductors and manufactured to IEC 502 and shall be type TCSA. The cables shall be 3-core, stranded copper conductors cross-linked polyethylene insulated, lead-sheathed, single sire armoured, pvc outer sheathed for operation up to and including 6350 volts to sheath and 11000 volts between conductors.

The cable shall be made from circular stranded compact metal-coated annealed copper conductor as per IEC 228.

The insulation shall be dry cured cross-linked polyethylene (XLPE), uniformly blended and disposed.

The insulation shall be applied by extrusion process and shall form a compact homogeneous body.

The insulation shall concentrically cover the conductor.

There shall be conductor and insulation screens, consisting of non-metallic semi-conducting material. The interface between the screen and insulation shall be smooth. The conductor screen shall be free from irregularities and have no marked peaks.

The cable shall be cored with suitable non-hygroscopic inner covering preferably XLPE material and filler to make a substantially circular cable.

A conducting tape of copper shall be applied helically with overlap over the cabled cores.

An inner sheath of lead alloy shall be extruded over the cabled cores. The lead alloy shall comply with the requirement of BS 801.

The armour shall consist of a proven design, preferably single layer of galvanized steel wire and suitable tape applied helically over it.

Extruded oversheath shall be of black polyvinyl chloride (PVC). The individual cores shall be identified by coloured tape over the insulation and the colour shall be red, yellow and blue.

The cable shall be clearly and permanently embossed with the following information throughout the length of the over sheath. Letters and figures, raised and consist of upright block characters. Minimum size of characters not less than 15% of average overall cable diameter.

3.11 **Standard Sizes and Characteristics**

The standard sizes for the XLPE cables shall be as follows:

<table>
<thead>
<tr>
<th>Conductor nominal sectional area</th>
<th>Sq. mm</th>
<th>50</th>
<th>95</th>
<th>120</th>
<th>185</th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductor shape</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness of insulation</td>
<td>mm</td>
<td>3.4</td>
<td>3.4</td>
<td>3.4</td>
<td>3.4</td>
<td>3.4</td>
</tr>
</tbody>
</table>

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Approximate thickness of shielding tape | mm | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
--- | --- | --- | --- | --- | --- | --- |
Diameter of armour | mm | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
Thickness of outer sheath | mm | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
Approximate overall diameter | mm | 52 | 60 | 64 | 71 | 84 |
Test Voltage | kv/5 min | 15 | 15 | 15 | 15 | 15 |
Maximum conductor resistance | Ω/km | 0.493 | 0.247 | 0.196 | 0.128 | 0.0797 |

3.12 **Tests**

Conductor resistance test, high voltage test and insulation resistance test shall be done in accordance with the requirements of IEC 502.

3.13 **Packing**

The cable shall be wound on wooden drums such as to prevent damage during transportation. The wooden drums shall be made from treated timber resistant to termite attack.

3.14 **Jointing**

This specification covers heat shrinkable jointing and terminations for use on cables operating up to and including 6300 volts to sheath and 11000 volts between conductors and is based on ESI 09 – 13.

This specification covers the heat shrink termination and jointing kits for use on XLPE cables.

The terminations and joints shall be of heat shrinkable material suitable for use in terminating XLPE submarine cables with conductors of stranded aluminium or copper.

The termination or jointing material shall have an internal insulating tubing component which shall provide adequate insulation over the conductor at the cable joint or termination.

The termination or jointing material shall have a stress control tubing component which shall provide proper electrical stress control at the operating voltage over the insulated cable cores at the joint or termination.

The termination or jointing material shall have an anti-tracking tubing which shall provide resistance to tracking and erosion of the material.

The terminations and joints shall be designed and manufactured to ensure that all components and materials shall be suitable for use in the atmospheric conditions stated in Clause 2.

The complete components and materials shall be free from defects which would be likely to cause them to be unsatisfactory in service.

The components and materials shall be manufactured to ensure high moisture sealing capacity, resistance to fungal and insect attack, proper stress control and resistance to tracing when in service.
Components shall be marked clearly and permanently with the following:

(i) Manufacturer’s name.
(ii) Manufacturer’s reference number

All electrical conducting components shall be marked “conducting” clearly and permanently.

Components and materials shall be packed as a complete kit.

The kit shall be clearly marked with the following identification:

(i) Manufacturer’s name.
(ii) Batch reference.
(iii) Applicable voltage.
(iv) Applicable cable sizes.

Packing shall be designed to protect against ingress of moisture and mechanical damage.

Performance tests shall be done in accordance with the requirements of ESI standard 09 – 13.

3.15 References

The following documents were referred to during the preparation of this specification. In case of conflict, the provision of this specification shall take precedence.

Unless otherwise specified, the latest revision, edition and amendments shall apply.

IEC 502 : Extended solid dielectric insulated power cables for rated voltages from 1kV up to 30kV.

IEC 228 : Conductors of insulated cables.

BS 801 : Specification for composition of lead allay sheaths of electric cables.

BS 5467 : Armoured cables with thermosetting insulation for electric supply.

ALCATEL : KABELMETAL – Cables Catalogue.


ESI 09.13 : Performance specification for high voltage heat-shrinkable components for use with high voltage solid type cables up to and including 33000 volts.
4 PART D: BUILDING POWER CENTRE

4.1 Scope of Works

The scope of works shall entail fabrication of 3No switchboards (Main, West wing and East wing Power Centres) LV. switchboard, power factor correction banks, power stabilizers, changeover system and generator cabling and terminations.

This section of the Specification covers the following:

(i) The supply of a new main L.V. Switchboards complete with Air Circuit Breakers (ACB’s), Moulded Case Circuit Breakers (MCCB’s), Fire/emergency shunt trips, contactors BMS contact points and the ancillary equipment associated with the main L.V. Switchgear.

(ii) Installation, testing and commissioning of the new main L.V. switchboards in accordance with the Contract Drawings and Specifications.

4.2 Contract Drawings

The Tenderer's attention is drawn to the following Contract Drawings which are particularly relevant to this section of the works:-

(i) EP_003
(ii) EP_004.1
(iii) EP_004.2
(iv) EP_004.3
(v) EP_004.4
(vi) EP_004.5
(vii) EP_004.6
(viii) EP_004.7
(ix) EP_004.8
(x) EP_004.9
(xi) EP_004.10
(xii) EP_004.11
(xiii) EP_004.12

The Tenderer shall be deemed to have studied all the Contract Drawings listed in Appendix I of this Specification, and to have allowed for any necessary provisions in this section of the works required thereby.

4.3 BUILDING POWER CENTRE SWITCHBOARD

The main Building Power Centre L.V. Switchboard shall be self-supporting floor-mounted cubicle with front access incorporating the equipment as detailed on the Main Schematic Diagram of Electrical Distribution.

The switchboards shall be manufactured in accordance with Section 4 Part B of this Specification to IP54, Form 4B. It shall Type-Tested to Kenya Bureau of Standards.

The switchboard shall be capable of extension and the bus bar section shall allow for this provision. The Engineer reserves the right to make such variations to the layout and dimensions of the switchboard as are deemed necessary to suit site conditions.
The ACB’s shall comply with IEC IEC 60947-2 with minimum breaking capacity of 80kA at 415V TP as manufactured by ABB/Siemens /Schneider/ or equal and approved.

The MCCB’s shall comply with IEC 60947-2 with minimum breaking capacity of 50kA at 415V TP as manufactured by ABB/Siemens /Schneider/ or equal and approved.

MCB’s shall comply with IEC IEC 60898-1 with a minimum breaking capacity of 20 kA at 240V SP and 10kA at 415 TP and shall be as manufactured by ABB/Schneider/Siemen or equal and approved.

4.4 **General Requirements**

Switchgear, comprising switchboards and loose gear, shall be provided as described herein and detailed in the schedules and/or shown on the drawings.

The Supplier shall submit his Tender details of any internationally recognized Standards and Code of Practice he proposes to use in addition to those stated.

All switchboards and so far as is practicable, all items of loose gear shall be of the same manufacture but, in any case, all items of like kind shall be of the same manufacture.

The Supplier shall submit with his Tender a dimensioned outline drawing of switchboard showing all leading dimensions and the estimated weight of the board.

The Manufacturer's Switchgear, Fabrication, Builders Work and Installation drawings shall show, in addition to the requirements previously stated, all significant details of the switchboard including:-

i) Equipment incorporated in switchboard.

ii) Fuse, circuit-breaker and switch ratings.

iii) Current and voltage transformer ratios, class terminal markings and output.

iv) Instruments, including scale details and accuracy class.

v) Relay types and characteristics.

vi) Position of switches, and details of function.

vii) All internal connections, with terminal markings. (Note that circuit diagrams shall show all switches, relays, contactors, etc. in the open or de-energized condition).

viii) Arrangement of terminal boards.

ix) All plug contacts

x) Wire numbers.

xi) Size, type and colour of secondary wiring.
xii) Principal physical dimensions, including clearances required for removing covers, opening doors, operating handles, withdrawing equipment, or gaining admission for maintenance.

xiii) Position of all panel face equipment, including dimensions of all projecting apparatus.

xiv) Identification of all equipment, with type references and the appropriate label inscriptions.

xv) Foundation details, including weights, support points and any reinforcement of foundations needed to withstand dynamic forces arising from switchgear operations under normal service or fault conditions.

xvi) Cable entry details including gland and gland plate provisions.

The switchboard shall incorporate all of the items of equipment detailed in the schedule and/or shown on the drawings. It will also be fitted with a shuntrip switch for use in case of emergency. The push button will be mounted at an accessible location.

4.5 Standards

The schedules shown on the Drawings detail the requirements for switchgear up to 1000V a.c. Labeling shall comply with details under 'Item No' and 'Description' on the schedules.

The switchboard shall be a type tested assembly in accordance with KS IEC 61439 standard as per Kenya Gazette Notice 8489 of 14th December, 2001. Assembly proposals shall be accompanied by Type Tests relevant certificates.

In addition switchboards shall conform to the requirements of the BS 5486 except where more onerous conditions are specified in the schedule in accordance with the definitions contained in the BS 5420 and BS 5490.

Cable terminations and space for termination shall be suitable for the sizes of cable called for in the design and shall not be limited to mere compliance with BS 5486.

Circuit-breakers in switchboards shall comply with BS 4753: Part 1.

Moulded Case Circuit Breakers (MCCBs) shall comply with BS 4752: Part 1 and shall be of current-limiting type with inverse time delay, instantaneous short circuit and earth leakage trips.

Disconnecters and switch-disconnecters shall be to BS 5419 and shall be of ratings suitable for the equipment served and with fault capacities compatible with the remainder of the equipment on the switchboard.

4.6 Electrical Characteristics

All of the switchgear described herein shall be suitable for connection to a 415/240V 3-phase 50Hz 4-wire supply system.
All disconnecters, switch-disconnecters, switches and circuit-breakers shall be provided with the means to enable them to be locked in the 'off' position. When used as earthing switches they shall be capable of being locked 'on' when closed to the earth connection.

Four-pole, air insulated busbars of uniform cross-section throughout their length, with a continuous current rating not less than that indicated in the schedules and/or drawings shall be arranged horizontally and vertically through each switchboard. Current ratings shall take account of reduction in section caused by drilling for connections and supports.

The busbars and the connections from them to the various items of switchgear shall be manufactured from tin plated hard drawn high conductivity copper, and the whole busbar assembly comply with BS 159.

Busbars shall be supported on non-hygroscopic, non-tracking insulators of sufficient strength to withstand, without damage, the forces set up, either by thermal effects during normal operation or by electromagnetic effects under short circuit fault conditions.

Busbars shall be housed in separate compartments, which shall not contain any wiring or apparatus other than that for connecting to the busbars.

Access to busbars and busbar connections shall be possible only after the removal of covers secured by bolts or studs. Such covers shall be identified externally by Formica engraving laminate labels bearing the inscription 'BUSBARS' in black lettering not less than 10mm high on a white background.

The cross-sectional area of the neutral busbar shall equal that of a related phase bar.

Each cubicle or box section shall be provided with sufficient busbar links to enable cubicle sections to be easily joined. Facilities shall also be provided for extending the busbars to extra cubicle sections, if required, at some later date.

All equipment which is not specifically earthed separately shall be bonded to the main earth bar by means of copper strip in accordance with CP 1013 with a minimum size of 25mm x 3mm.

4.7 Products/Materials - Enclosures

Unless otherwise indicated on the drawings or in the schedules, all switchboards shall be suitable for installation indoors.

Switchboards other than industrial type shall be self-contained, free-standing, floor-mounted, multi-cubicle From 3 or multi-box type as called for in the schedules and shall be constructed in sections where necessary to facilitate transport and erection.

The overall height of each switchboard shall not exceed 2.3 metres unless shown otherwise on drawings.

Each switchboards shall be capable of extension at both ends. Busbar chambers shall be fitted with removable end covers.

Switchboards shall be designed for live working so that cabling of outgoing circuits can be safely carried out without de-energizing the switchboard.
The individual cubicles from which Form 3 cubicle type switchboards are built shall be rigidly constructed from folded steel panels and sections firmly welded together, and the required number of cubicles shall be bolted or welded to form the shell of the switchboard.

Switchboards shall not be constructed by attaching flat steel plates to a framework of rolled steel angle unless so specified in the schedules or on the drawings.

All switchboards shall be provided with adequate lifting eyes, which shall be removed after the boards are in place and replaced by screw-in brass plugs.

When a switchboard is sectionalized for assembly on site, the sections shall be provided with adequate means of locating adjacent sections to ensure accurate alignment.

All equipment mounted in switchboards shall be fully accessible for maintenance.

Switchboards compartments shall be fitted with hinged doors, neoprene or foam rubber gasketed, and doors shall be provided with every type locking handles having integral cylinder locks. All locks shall be openable with a common key, the number of keys supplied being two per lock up to maximum of 10 per switchboard.

4.8 Metering equipment

All integrating watt-hour (and kWh) and reactive volt-ampere-hour (and kVArh) meters shall be of the induction disc type and shall be housed in flush-mounting pressed steel or aluminium alloy or plastic cases with bezels finished matt black or semi-gloss black except as provided in the next clause.

Integrating watt-hour (and kWh) meters for mounting independently of other electrical equipment (as in domestic type installations) shall be generally as described above but shall be housed in surface-mounting, pressed steel, aluminium alloy, or plastic semi-gloss black cases.

Single-phase and three-phase integrating watt-hour (and kWh) meters shall comply with all relevant requirements of BS 5685.

Single-phase and three-phase integrating meters for reactive volt-ampere-hours (and kVArh) shall comply with all relevant requirements of BS 37: Part 1 and Part 9.

Polyphase meters for registering maximum demand in kilowatts (or MW) shall comply with Parts 1 and 5 of BS 37: they shall have long scales covering an arch of not less than 270 degrees, and shall operate on the basis of a 30 minute demand integration period.

All meters covered by the preceding clauses shall have an accuracy class designation as follows:-

- Tariff metering Class 1.0
- Non-tariff metering Class 2.0

All three-phase meters shall be suitable for operation on a four-wire system with unbalanced load.
All meters shall be provided with means whereby they can be sealed to prevent unauthorized interference.

All integrating meters shall be the products of reputable manufacturers such as Siemen/L&T/Schneider or equal and approved.

4.9 Current Transformers

Current transformers shall be of the type, rating and ratio detailed in the schedules or on the drawings.

All current transformers shall comply with all relevant requirements or BS 3938 and shall have an accuracy class designation according to the following table.

<table>
<thead>
<tr>
<th>Current transformer function</th>
<th>Accuracy class designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tariff metering</td>
<td>0.5</td>
</tr>
<tr>
<td>Non-Tariff metering</td>
<td>1.0</td>
</tr>
<tr>
<td>Switchboard indicating</td>
<td>1.0</td>
</tr>
<tr>
<td>Instruments</td>
<td>1.0</td>
</tr>
<tr>
<td>Motor starter ammeters</td>
<td>3.0</td>
</tr>
<tr>
<td>Protection</td>
<td>5P</td>
</tr>
</tbody>
</table>

Unless otherwise stated in the schedules or on the drawings, the current transformers are required for use under conditions not more onerous than those set out in BS 3938.

Current transformers shall be designed either for measurement or for protection and shall not be used in a dual-purpose role serving both instruments and protective gear.

Unless otherwise specified, all current transformers shall have 5A secondary windings.

So far as it is practicable, all current transformers shall be of the ring type; wound primary current transformers will only be accepted when the rated primary current is so low as to make the ring type impracticable.

All current transformers whether of the ring type or the wound primary type, for use at voltages exceeding 1000V shall be epoxy resin encapsulated.

Where dual-ratio current transformers are called for, they shall be provided with two separate secondary windings capable of being connected in series or in parallel to give the required ratio.

All current transformers shall be provided with a rating plate bearing the information set out in BS 3938.

Current transformers which are to be installed in reasonably accessible places shall be equipped with an adequate terminal board or block; terminals shall be marked in the manner laid down in BS 3938.

In the case of current transformers which are to be installed in inaccessible locations, the secondary connections may be brought out by means of insulated leads to be made off on a suitable terminal block mounted in a readily accessible position.
The works supplier shall provide magnetization curves and/or type test certificates for each current transformer.

Every current transformer shall have a rated burden at least 50% greater than the total burden of the instruments, relays and/or other apparatus which it is to serve.

4.10 Voltage Transformers

Voltage transformers shall be of the type, rating and voltage ratio detailed in the schedules or on the drawings.

All voltage transformers shall comply with all relevant requirements of BS 3941 and shall have an accuracy class designation according to the following table.

<table>
<thead>
<tr>
<th>Current transformer function</th>
<th>Accuracy class designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metering</td>
<td>1.0</td>
</tr>
<tr>
<td>Switchboard indicating</td>
<td>1.0</td>
</tr>
<tr>
<td>Instruments</td>
<td>1.0</td>
</tr>
<tr>
<td>Motor starter voltmeters</td>
<td>3.0</td>
</tr>
<tr>
<td>Protection</td>
<td>3P</td>
</tr>
</tbody>
</table>

Unless otherwise stated in the schedules or on the drawings, the voltage transformers are required for use under service conditioning not more onerous than those set out in BS 3941.

Voltage transformers designed for a primary voltage not exceeding 4000 volts shall be air insulated type, with the windings encapsulated in epoxy resin or other suitable synthetic material.

Voltage transformers designed for a primary voltage greater than 4000V shall be of the oil immersed type contained in a welded steel tank filled with mineral insulating oil to BS 148.

Unless otherwise specified, all voltage transformers shall be designed for a secondary output voltage of 110V.

Each voltage transformer shall have a rated burden at least 50% greater than the total burden of the apparatus or instruments which it is to serve.

The insulation resistance of each voltage transformer shall be indelibly marked on the shipping/dispatch label.

4.11 Sub-Main Switchboards

The sub-main switchboards shall be self-supporting floor-mounted cubicles with front access incorporating the equipment as detailed in the schematic wiring diagrams. They shall be supplied complete with all internal connections, cable glands and boxes.

The switchgear shall match those of the main LV. switchboard in manufacture with the appropriate discrimination between MCCBs and MCBs being maintained.
4.12 Distribution Boards Consumer Units

The distribution boards and consumer units shall conform with the requirements of Clause 4.15, Part B of this Specification and shall be as manufactured by M/S Merlin Gerin or equal and approved.

Distribution boards and consumer units shall be flush/surface mounted.

Residual Current Circuit Breakers [RCCB] where specified shall be incorporated in the distribution boards and consumer units’ outgoing ways in place of mcbs for individual final circuit protection and shall be as ABB or equal and approved.

Schematic of individual distribution boards and consumer units have been prepared. The Sub-Contractor should note that power boards consist of single phase and three phases sub-circuit ways.

All neutral conductors in a single phase distribution boards and consumer units shall be connected in the same circuit sequence as its phase conductors, i.e. phase wire No.1 connected to No.1 terminal on the neutral bar.

In addition to this requirement for every distribution board each phase and neutral conductor shall have clipped to its sheath in the distribution board a clip-on numbered tag corresponding to its circuit number. The tags shall be of a type manufactured by M/S Critchley Brothers Limited. All circuit numbering shall commence from left to right.

4.13 L.V. Earthing

The sub Sub-Contractor shall provide a complete and effective system of earthing for the L.V. electrical installation.

The system of earthing shall comply with the IET wiring regulations and the recommendations stated in CP 1013, except where detailed otherwise in this Specification and the drawings. Where the IET wiring regulations and CP 1013 differ then the former shall take precedence.

Metallic services including gas mains, dry risers, etc, entering or leaving the building or structure shall be effectively bonded to the main earthing terminal at their point of entry or exit. Connections shall be made to the services with purpose-made earthing clamps to BS 951.

The lightning conductor system for the building or structure shall be effectively bonded to the main earthing terminal in accordance with the requirements of CP 1013. The bonding conductors shall not be smaller than 25mm x 3mm. A suitable label shall be provided adjacent to this bonding connection at the main earthing terminal.

Where the building is comprised of a steel framed structure or has metallic cladding then these shall be effectively bonded to the main earthing terminal.

The cross-sectional area of all earthing, bonding, and protective conductors shall comply with the requirements of the IET wiring regulations. Except where detailed otherwise in this specification or on the drawings all conductors for earthing shall be copper manufactured in accordance with BS 1432, from strip and BS 4109, for cables.
Single-core cables forming part of the earthing system shall be of stranded copper, insulated to 450/750V standards with green/yellow PVC. These cables shall comply with BS 6004, Table 1. Bare protective conductors in twin and three core cables included in BS 6004, Table 5 will be acceptable.

Mechanical joints between aluminium and copper shall have the joint faces lightly coated with a suitable compound to prevent corrosion, before the connection is made.

Where conduits or small glands for mineral insulated or armoured cables, terminate on switchgear, distribution boards, starter panels or other apparatus then brass compression washers shall be used to ensure an effective earth connection.

Where connections are made between sections of trunking then the manufacturer's earth continuity links shall be installed across the joint. Connections made between trunking sections crossing a building expansion joint shall be made with a flexible copper braid.

Sections of cable tray shall be thoroughly cleaned before overlapping and securing with a minimum of two screwed fixings. The remote ends of the cable tray shall be effectively bonded to the earthing system.

The armouring of plastic sheathed cables terminate in a suitable compression glad fitted with a purpose-made earth tag. A suitable protective conductor shall connect the earth tag with the apparatus earthing terminal. The earth tag shall be manufactured from a high conductivity material compatible with the cable gland.

The armouring of metal sheathed cables shall be securely clamped to the gland at the cable termination with a purpose-made bolted clamp. A protective conductor shall be installed to connect the armour clamp or gland fixing bolts to the apparatus earthing terminal.

For an outdoor termination the armouring shall be suitably protected to prevent corrosion.

Metal sheaths and/or armouring of multi-core cables connected to a cubicle type switchboard shall be effectively connected to the switchboard earth bar as described in later clauses.

The earth terminal of all socket outlets shall be connected to the main protective conductor of the final sub-circuit. Where the protective conductor is formed by conduit, trunking or the metal sheath and/or armouring of cables then the earth terminal of the socket outlet shall be connected to an earth terminal in the box or enclosure associated with the conduit, trunking or cable.

Connections between earth bars, equipment frames, etc. and stranded copper cables shall be made with the appropriate lug, bolt, washers, nut and lock nut. The cable shall be seated into the lug and the contact surfaces shall be thoroughly cleaned and tinned prior to connection.

The washers shall be of sufficient size to prevent any distortion of the copper strip.

The diameter of fixing holes shall not exceed one-third the width of the earth bar or strip. Where a larger hole is required in an earth bar then connection shall be made to a suitable copper flag welded to the bar.
Copper strip joints shall be riveted and soldered using hard silver solder and suitable copper rivets, four to a joint and not less than 6mm from the edge of the copper strip. The amount of overlap of the two strips to the jointed shall not be less than the width of the larger conductor.

4.14 Test Requirements

Tests shall be made and recorded on the electrical installation earthing system in accordance with chapter 6 and appendices 14, 15 and 16 of the IEE wiring regulations and the results recorded on copies of the 'Schedules of Test Results' attached to this Specification. Tests shall be made both during and upon completion of the works.

The schedule shall be completed for each final sub-circuit and at each main and sub-main distribution point. Six typed copies of the completed schedules shall be available for inspection within fourteen days of the test completion.

These tests shall also be made on all plant and equipment supplied, installed and connected to the electrical installation under this sub-contract and/or existing plant and equipment connected to the electrical installation provided under this sub-contract.

The works Sub-Contractor shall re-set the earthing system provided under this sub-contract thirty days prior to the end of the Defects Liability Period. The Works Package Sub-Contractor shall give seven days written notice prior to visiting the site to make these tests. Tests shall be carried out as aforementioned on the following basis:

(i) All socket outlets installed under this sub-contract shall be tested for earth fault loop impedance.

(ii) Two and a half per cent (2.5%) of all lighting points installed under this sub-contract with a minimum of five, shall be tested for earth fault loop impedance.

Should any point not comply with the test requirements then a further two and a half per cent (2.5%) shall be tested, when failure of any one will require testing of all lighting points.

(iii) All miscellaneous plant machinery and equipment supplied and installed under this sub-contract shall be tested for earth fault loop impedance.

3.12.1 Schedule of Test Results for the Electrical Earthing Installation.

<table>
<thead>
<tr>
<th>Job No:</th>
<th>Schedule No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job Title:</td>
<td></td>
</tr>
<tr>
<td>Building:</td>
<td></td>
</tr>
<tr>
<td>Department:</td>
<td></td>
</tr>
<tr>
<td>Switchboard/Distribution Board Ref:</td>
<td></td>
</tr>
<tr>
<td>Method of Main Earth Connection:</td>
<td></td>
</tr>
</tbody>
</table>

| cable or Circuit fuse or Protective conductor earth fault |

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<table>
<thead>
<tr>
<th>Circuit ref.</th>
<th>Breaker rating (Amps)</th>
<th>Resistance (Ohms)</th>
<th>Loop impedance (Ohms)</th>
</tr>
</thead>
</table>

Sub-Contractor:

Date:
4.15 Air Circuit-Breakers

Air Circuit-Breakers shall comply with BS 4752: Part 1. For 3 phase circuits they shall be triple pole and suitable for the short-time withstand current given in the schedules. The short time current shall be supplied at 415V for 1.0 second. The short-circuit performance category shall be P-2.

Where circuit-breakers are required to break the neutral, details are given in the schedules; if no details are given then a bolted neutral link shall be fitted.

Air circuit-breakers shall be horizontal draw-out pattern, with full load current ratings for uninterrupted duty under standard service conditions, as detailed on the drawings and schedules.

Withdrawable circuit-breakers shall have automatic safety shutters for screening the fixed contacts when the circuit breaker is withdrawn to the inspection position. The action of withdrawing a circuit-breaker shall necessitate a deliberate action distinct from any other operation; it shall not be possible to withdraw a circuit-breaker from its housing inadvertently.

The number and combination of normally open and two auxiliary contacts shall be a minimum of two normally open and two normally closed unless otherwise detailed in the schedules.

The circuit-breakers shall be fitted with clearly visible mechanically operated ON/OFF indication as detailed in BS 4752: Part 1. Contact separation shall comply with the requirements of the IEE writing regulations.

A lock shall be fitted on the circuit-breaker closing mechanism so that only the key holder can close the breaker. Facilities shall also be available for the circuit-breaker to be locked in the open position. The operating mechanism shall be of the trip free type.

The specific method of closing the circuit-breaker mechanism shall be as called for in the schedules and shall be in accordance with the following:-

(i) Type MSO

Manual, Spring Operated closing arrangement with a handle for charging and releasing the spring in one stroke. or

BS 3871 Specification for miniature and moulded case circuit-breakers.

BS 4099 Colours of indicator lights, push buttons, annunciators and digital readouts.

BS 4727 Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms. Part 2: Group 06: switchgear and control gear terminology (including fuse terminology)

BS 4752 Specification for switchgear and controlgear for voltage upto and including 1000 V a.c. and 1200V d.c.
BS 5419 Specification for air-break switches, air-break disconnecters, air-break switch disconnecters and fuse-combination units for voltages up to and including 1000V a.c and 1200 V d.c.

BS 5420 Specification for degrees of protection of enclosures of switchgear and control gear for voltages up to and including 1000V a.c and 1200 V d.c.

BS 5486 Low-voltage switchgear and control gear assemblies.

BS 5490 Specification for classification of degrees of protection provided by enclosures.

BS 5992 Electrical relays.

BS 6121 Mechanical cable glands.

BS 6231 Specification for PVC-insulated cables for switchgear and control gear wiring.

CP 1013 Earthing

(ii) The size, rating and details of the switchgear and cabling are shown on the contract drawings.

4.16 **Moulded Case Circuit Breaker (MCCB):**

All MCCB’s shall be universal mounting line load interchangeable and with door interlock & handle.

All MCCB’s on Sub Distribution Panels shall be provided with variable setting Thermomagnetic & all MCCBs with microprocessor based release on Main LT Panel & PDB/sub panel incomer only. Door handles will be provided with pad locking arrangement. All MCCB’s on Main panel shall be provided with shunt release and Auxiliary contact block. All MCCB’s shall be provided with suitable spreader links on both sided for bus bar and cable connections. All MCCB’s used, as incomers to PDB’s and sub panels, MLDB shall be provided with shunt release & Aux contact Block. MCCB’s shall have clear ON, OFF & TRIP positions. Specific requirement of switchgear for BMS purpose shall be referred.

F.6.4.3 SWITCH DISCONNECTOR FUSES: These will be used only if specified and shall be with Door interlock, handle with pad locking arrangement. Phase separators shall be provided on both sides. Clear OFF / ON position indicators shall be provide on handle. Fuses used shall be HRC only and shall be with 80 kA breaking capacity. HRC fuses shall have indication for healthy / blown fuse.

4.17 **Miniature Circuit Breakers (MCB)**

**Generally**

Miniature Circuit Breakers (MCBs) shall be rated for uninterrupted duty at 240/415 volts and shall comply with BS 3871: part 1 and IEC 898, plus any additional requirements of this specification.
MCBs shall be type tested by ASTA or an equivalent approved coordination testing authority. All MCBs shall be of the same manufacture. Manufacturer's tripping characteristics shall be provided for each type of MCB specified.

Service and ultimate short-circuit capacities, impulse withstand voltages and insulation levels shall be suitable for the location to the MCB in the system and the backup protection provided.

MCBs shall be fitted with fixed, non-adjustable, direct-acting thermal and magnetic trips and shall trip instantaneously (within 0.1 seconds) at currents above 5 and up to 10 times normal current rating, (C-type in IEC 898), unless otherwise specified.

Energy limiting MCBs shall break the circuit within 5ms. The 1.2 energy let-through shall be stated for each energy limited MCB. In multi-pole MCBs, including 4-pole, all poles shall open, close and trip simultaneously.

Mechanisms shall be quick-make, quick-break, over-centre type which are trip-free. The contact position shall be positively indicated by coloured bands and/or entering to show whether the contacts are open or closed. If the rating or the incoming supply to an MCB board exceeds 200A on any phase then moulded case circuit breakers shall be used in place of MCBs. As required by IEC 898 1987 plus amendments, the following information shall be provided for each MCB:

1. Rated current
2. Rated operational voltage and rated insulation voltage
3. Number of poles
4. Rated services and ultimate short-circuit capacities.
5. Type according to tripping characteristic i.e., Type B, C or D.
6. Method of mounting
7. Method of connection
8. Protection against external influence.
9. On request, the I^2t tripping characteristic curve.

Each MCB shall be marked as follows:

a) On the front of the MCB so that it is visible when mounted: Rated current, without the symbol 'A' preceded by the symbol of instantaneous tripping (B, C or D) e.g. B 16
b) Rated voltage
c) Manufacturer's name or trade mark
d) Type designation, catalogue number of serial number
e) Rated service short-circuit capacity in amperes
f) Reference ambient temperature if different from 30°C.

4.18 Power-Factor-Correction Capacitor Banks

The PFC main equipment will consist of two separate switch boards installed remotely where the largest power demand is i.e. Main Building Centre and Chiller Room:
• PFC 1 – Building Power Factor Correction.

The units shall be of the pre-assembled in factory type.

The kVAr rating of the PFC Bank shall be 2No. 800kVAr. However, the final rating of the capacitors shall be determined after installation and after as installed measurements have been taken on site. The Supplier shall make the necessary allowance for this in his bid.

The power factor capacitors shall be rated at 415V 50 Hz AC. The capacitors shall be dry resin encapsulated, shall have low lones and shall be self-healing and capable of withstanding maximum fault current of 10kVA and to confirm to IEC 831-1 (1996) and IEC 831-2 (1995). The capacitors shall be delta connected and shall incorporate automatic control regulator for maintaining power factor at the set level and regulating the switching of capacitors steps, with digital display of power factor, depending on load variations.

The power factor correction units shall incorporate harmonic reactors.

The average power factor correction shall be 0.98.

The capacitors shall have capacitance tolerance of 0, +10%. The installation shall withstand a voltage of 6 kV for one minute at 50 volts.

This equipment is to introduce gradual and suitable reactive power in order to assure an overall power factor not lower than 0.96 in every condition of operation of the EAKIP.

A general alarm will be reported to BMS in case of fault.

Capacitors shall be suitable to bear a maximum voltage of 450V and a maximum THD of 70%, to support all possible interferences injected by static electronic devices in the hospitals.

Since it is not recommended to let PFC operate during DG functioning, the upstream switches shall be released automatically according to the changeover ATS operations, reclosing only when DG results securely excluded.

Circuit arrangements shall be such that the power factor banks are out of circuit during the operation of the respective power standby generator.

4.19 Standby Generator Supply

Suitably rated diesel-driven standby generators shall be installed by others as follows:

• 2 No. generators designed to power the entire complex. The generators will be synchronized such that only one generator provides power during low peak hours.
• Shall be automatic-start through batteries.
• The generator sets output must be adequate to take full surge of total equipment load unless a controlled start up is incorporated.
• Shall be acoustically treated to minimize structural and airborne noise. Super silent models shall be proposed with approx. 65dB at 7m.
• Exhaust and hot air discharge shall be given due consideration to minimize nuisance to the users and control pollution.
• Fuel storage shall be accessible, safe from fire and adequate for at least 48 hrs. run at full load. Fuel transfer shall also be given due consideration.
• In addition day tanks of sufficient capacity shall be provided to allow an 8 hr. run at full load.
• The standby power supply shall be designed to operate with intermittent loads and shall be compatible with the UPS installation.

4.20 **Uninterruptible Power Supply (UPS)**

True-on-Line UPS shall be installed in the Server/Control room for the necessary provision of no-break in power during mains failure for the security and ICT System.

The system(s) configuration shall be the parallel redundant type with reverse transfer and designed for capacity expansion by addition of parallel modules on site with minimum downtime.

The UPS design shall conform to IET 519 standards.

4.21 **Voltage Stabilizers**

Appropriately rated voltage stabilizer(s) as manufactured by Claude Lyons Limited or other equal and approved manufacturer shall be specified.

The stabilizer shall comprise the following major units:

(a) A transistorized servo amplifier.
(b) A geared reversing motor.
(c) A continuously adjustable auto-transformer.
(d) A fixed ratio auxiliary transformer.

5 **PART E: L.V. CABLE DISTRIBUTION SYSTEM**

5.1 **Scope of Works**

This section of the specification covers the supply, installation, testing and commissioning of the main and sub-main cables, distribution boards and consumer units in accordance with the contract drawings and specification.

The sub-main cables and methods of installation shall be as shown on the Schematic and Layout Drawings and/or specified in Section 5 Part B of this Specification. The cables shall be from an approved manufacturer.

Distribution cables shall be run in trenches externally and on cable racks within the factory.

Types of cables

5.2 **Power Cables**

The most common cable conductor material used in building installations is copper. In some types of cables the copper may be tinned to prevent the copper from reacting with...
the insulation material. Aluminium is often used for power cables, particularly by the electricity companies. These require different termination and jointing techniques. They are not commonly used in building installations and therefore are not considered in this Guide.

Cables for specialist applications such as trace heating or underfloor warming may use materials such as copper-nickel or nickel-chromium alloys.

BS 6360 defines four classes of cable conductor:

- Class 1 has solid conductors
- Class 2 has stranded conductors
- Classes 5 & 6 are flexible cables and cords, with class 6 being more flexible than class 5.

The classes apply to both single core and multicore cables. The British Standards for the various cable types cover which classes of conductor are allowable for the different cross sectional areas. The standards covering most of the cables used for fixed wiring can have either solid or stranded conductors up to 10 mm sq CSA. However, in practice it will be found that these cables generally have solid conductors only for cables up to 1.5 mm sq or 2.5 mm sq and stranded conductors for the larger sizes.

Flexible conductors are commonly found in small sizes in multicore cable connections to luminaires and fixed equipment but are also used in large single core cables for the final connections to vibrating equipment such as generator.

5.3 **Cable Insulation**

The following cable insulation materials shall be used wherever specified.

1. Polyvinyl Chloride (PVC):
2. Thermosetting materials (XLPE & EPR):
3. Mineral Insulated (MI):
4. LSF & LSOH Insulation & Sheaths:
5. 'Fire-Resistant' Cables:

5.4 **Contactors**

Wherever possible, contactors shall be incorporated on the sub-main board, distribution boards or other switchgear.

Contact ratings, number of poles and coil ratings shall be as shown on the Contract Drawings. The Sub-Contractor shall ensure that the Contactors are adequately rated for the maximum prospective fault level in the particular part of the distribution system.

5.5 **Isolators**
Isolators shall conform with the requirements detailed in Clause 4.07 Part B of this Specification. Unless otherwise specified, isolators shall be designed for load making/load breaking duties.

5.6 **Cable Schedule**

The Sub-Contractor shall prepare a suitable cable route schedule for all major l.v. cables within the building. The schedules shall be submitted with working drawings after contracts have been exchanged. During the course of installation, each major cable shall be suitably identified along its route by trafficable cable markers, in accordance with the Sub-Contractor’s Cable Schedule.

5.7 **Electrical Services Associated with Mechanical Services & Medical Equipment**

Work to be carried out under this section includes the supply, installation, wiring to and connection, testing and commissioning of the electrical services associated with the mechanical services and medical equipment. These shall include ventilation, water pumps, kitchen equipment, air conditioning units, medical equipment etc.

The Mechanical Services Sub-Contractor or medical equipment supplies will supply and install the equipment and the associated control panels as shown on the Contract Drawings. The Mechanical Services Sub-Contractor shall be responsible for the interconnection wiring between the power isolator and their equipment via the control panel in accordance with the requirements of the Mechanical Engineer.

6 **PART F: LIGHTING AND POWER INSTALLATION**

6.1 **Scope of Works:**

This section of the specification covers the supply, installation, connection, testing and commissioning of the lighting and single phase power installation in accordance with the contract drawing and specifications.

6.2 **Wiring System**

Final sub-circuit wiring shall be carried out using XPLE single core insulated copper cables enclosed in a system of high impact heavy gauge surface metallic conduits and embedded PVC in the fabric of the building. An insulated earth continuity conductor shall be enclosed in all non-metallic conduits.

Wiring in the factory and plant rooms shall be in surface mounted galvanised conduits, trunking or cable trays.

A system of three compartment PVC surface mounted trunking shall also be installed with office areas as shown on the contract drawings as part of the floor cable management system to distributed power, information, communication and signal cables. Sub-contractor shall supply and install the necessary power outlets mounted on the trunking. The information, communication and signal outlets shall be by others.
All single phase 13 ampere power socket outlets shall be wired using 30 ampere ring main circuit system for raw power while all ‘clean line’ (UPS Supplied) 13A socket outlets shall be wired using 10A radial circuit system. No more than 4 No. twin socket outlets shall be wired in one radial circuit. All socket circuits shall be wired in 2.5mm² pvc insulated single core cables.
6.3 **Accessories - General**

Accessories shall comply with the relevant British Standards quoted in the later clauses referring to specific accessories. All accessories shall comply where applicable with the general requirements specified in BS 5733 and BS 6220.

Each type of accessory where applicable shall be of the same manufacture and where necessary of the same maker’s catalogue number or description to provide consistent appearance and finish.

Flush mounting accessories shall be fitted into purpose made metal boxes, only and surface mounting accessories shall be fitted onto metal or all insulated moulded boxes as shown on the drawings or in the schedules.

All boxes or sections for use with accessories must incorporate a suitably marked earth terminal accessory plates shall be secured to boxes by not less than two fixing screws. Where these screws do not provide adequate earth continuity to metal plates or plates including parts to be earthed continuity to metal plates of plates including parts to be earthed bonding connection shall be provided from the earth terminal to insulated sleeve. The above requirement shall not apply to the earth terminal on a socket outlet when directly connected to protective conductor. Where more than one phase of a supply exists in a multigang box the following requirements shall apply:

A clearly visible label showing the maximum voltage present shall be arranged as a warning notice before access can be gained to live parts. Wiring and accessories connected to each phase shall be separated from each other by fixed screens or barriers.

**Switches**

All switches for lighting and associated circuits shall comply with B.S. 3676 and shall be quick make and break for use on d.c. supply, pole and rated not less than 20A, 240V for use only on a.c. BS 3676.

Switches for control of water heaters, radiators, and so forth shall be double pole and rated 20A, 240V for use only on a.c. systems and shall include neon pilot lamp.

Switches shall be one-way or two-way or intermediate as indicated on the drawings. Switches for lighting shall be of the metal grid switch system with rocker operation, and in single or multigang formation as detailed on the drawings or in the schedules. Architrave type switch units shall only be fitted if shown on the drawings or in the schedules.

Switches installed in damp areas or outside shall of non-tracking plastic, single pole, operated by external means. The switch enclosure shall be either weatherproof of galvanised metal construction and designed to protection level IP54 of BS 5490 or splashproof plastic to IP54 requirements.

Ceiling switches shall be of the all insulated pull cord type suitable for mounting on a British Standard conduit box and having an overlapping plate. Each unit shall be complete with 1.5m white cord terminating in a white/red accord. The unit shall be rated at 20A at 240V and suitable for inductive fluorescent or resistive loads to BS 3676.
Push buttons in single units or forming part of a multigang unit shall be rated at 20A at 240V. The switch shall be single,double-pole and arranged for push to make/to break the contacts. The bezel shall be marked by an appropriate symbol legend symbol and have a white finish.

The time delay switches shall comply where applicable with the general requirements for switches.

The switch shall be suitably rated to control tungsten filament lighting at 240V a.c. up to a load of 400 watts. The switch shall be of the push on type and returning automatically to off after the time delay. The time delay setting shall be internally adjustable over a time range up to 10 minutes.

Lighting switches shall be flush-mounted, single pole 10 or 15 ampere rating, rocker operated with wide rockers as MK Logic Plus white in door. Grid switches flush-mounted may also be necessary in certain situations.

In medical plant rooms and storage areas surface switches and socket outlets shall be metal clad with rocker operated switches and shall have cover plates. Power socket outlets and spur units shall be surface mounted on wall or 13 ampere rating trunking with rocker-operated switches and neon indicators.

Circuits on the uninterruptible power supply (UPS) shall comprise of non-standard 13 amp socket outlets complete with non-standard plug tops. The outlets shall be white as MK Logic and shall be indelibly engraved “CLEAN UPS SUPPLY”. The non-standard socket outlets ‘EARTH’ terminal shall not be bonded to the normal power metallic distribution system to facilitate ‘CLEAN EARTH’. A separate earth system shall be provided at the sub-circuit consumer unit and distribution boards specifically for the clean earth system which shall eventually be bonded to the general building externally.

Note that all lighting and single phase accessories shall be ‘MK’. Or equal and approved.

### 6.4 Cable Management System

A system of two compartment metal trunking shall be installed as shown on the Contract Drawings in offices.

The system shall be used to distribute power, telephone services and computer data cables. The Contractor shall supply and install 13A non-standard and standard socket outlets and telephone outlet plates which shall be mounted on removable sections of the trunking cover plate.

Sizes, proposed fixing arrangements and routes of two compartment cable trunking have been detailed on the layout drawings. Proposed routes at each area, in relation to mechanical services, have been detailed but it is the Contractor’s responsibility to verify the routes of other services before submitting working drawings and commencing with the installation.

The Contractor shall tape together at 2 metre intervals all single core cable circuits which are enclosed within the cable trunking.

Surface high level and wall fixed metallic cable trays and ladders shall be employed for factory power distribution as indicated on drawings.
The powder coating shall be of uniform thickness of about 180 microns throughout the entire system. Colour uniformity shall also be strictly maintained through the entire system.

The trunking shall have no sharp edges (edges shall be bend where possible) and shall be reinforced to ensure that it shall not buckle.

Particular attention shall be paid to those areas, where conduits enter the trunking to ensure a dirty and neat installation where power, voice and data cable ways are completely and neatly segregated. A sample section shall be prepared before installation commences.

The Sub-Contractor shall allow for all trunking inter-connecting conduits.

6.5 **High Current Switches**

All high current d.p switches shall conform to B.S. 3676: Part 1: 1994 and shall be rated at 32A/45A resistive double pole operation 45 A switches shall have terminal capacity to accept 4 x 4 mm\(^2\), 3 x 6 mm\(^2\) and 1 x 16 mm\(^2\). 32A switches shall have trimmed capacity to accept 3 x 2.5 m\(^2\), 2 x 4 mm\(^2\) and 1 x 6 mm\(^2\). They shall be MK.

6.6 **Luminaires (Lighting Fixtures)**

Luminaires shall be of the type and manufacture as detailed in the schedule of Luminaires.

The luminaires have been itemized with a suggested manufacturer and the statement “equal and approved”. “Equal and approved” shall mean equal in electrical characteristics, photometric data, size, cross-sectional area, finish and fixing details.

Luminaires in the factory shall be surface mounted on ceiling slabs. Where suspension is called for the pricing of the luminaire shall be complete with the suspension as specified.

All luminaires shall be supplied complete with gear, lamps and tubes of the voltage specified and shall be power-factor corrected (NPF) in the case of fluorescent luminaires.

All fluorescent tubes shall be of the colour specified as manufactured by GE, Osram or Philips.

6.7 **Emergency Lighting**

The emergency lighting system shall comprise of maintained luminaires containing one or more lamps, which operate from the internal emergency battery supply only upon failure of the normal mains supply. In addition emergency lighting shall also incorporate sustained (combined emergency luminaires) non-maintained and maintained ‘EXIT’ lights.

The system design shall conform to BS 5266 parts 1 and 7 1999.

6.8 **Information, Communication and Signal System**

Installation of conduit ways and trunking systems shall be installed by the Electrical Sub-contractor to facilitate installation of information, communication and signal system cables and accessories.

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The installation of information, communication and signal cables and accessories shall be by others. The Electrical Sub-contractor shall offer these specialist due attendance and shall be deemed to have allowed for the same in his tender.

6.9 **Socket outlets**

Socket outlets for 240V a.c. supplies shall be of the 13A rectangular pin single pole switched type complete with shutters and shall comply with BS 1363. Each socket outlet shall be provided with a plug of the appropriate rating. Plugs for 13A socket outlets with sleeved insulated pins shall be made in hard plastic complying with BS 1363 and shall be supplied compete with 13A or 3A fuse links to BS 1362 in accordance with the drawings. Plugs for ratings of 2A, 5A, or 15A shall comply with BS 546 and be made in hard plastic. Where detailed on the drawings or in the schedules plugs made of resilient material shall be supplied.

Weatherproof switch socket outlets and plugs for outside use shall be of all metal enclosure for surface mounting. The switch shall be singe pole/double pole having a substantial operating arm with ON/OFF positions clearly indicated. The outlet socket shall be protected when not in use with a screw-on metal cap attached to the unit by a chain/hinged spring closing flap incorporating a gasket. The metal enclosure shall have a hop dip galvanised finish and shall be protected by 30mA RCD devices.

6.10 **Cable Outlet Units**

Outlet plates for cables or flexible cords shall be similar to switch plates with 60.3mm fixing centres and complete with not less than two fixing screws. Terminals shall be provided to accommodate incoming wiring and outgoing cables or 1.5mm² flexible cord. The unit shall be unfused and shall incorporate an outgoing cable clamp or cord grip. The cover plate of white moulded plastic shall have a smooth aperture for the cable/flexible exit.

6.11 **Isolators (Loose Equipment)**

Isolators shall conform to the requirements detailed in Clause 4.07 Part B but with the exception that solid links shall be inserted in place of HRC fuses. The solid links shall be suitably sized to carry the full rated current of the respective isolators. Unless otherwise stated, isolators shall be designed for load making/load breaking duties.

6.12 **Cable Schedule**

The Sub-Contractor shall prepare a suitable cable route schedule for all major l.v. cables within the building. The schedules shall be submitted with working drawings after contracts have been exchanged. During the course of installation, each major cable shall be suitably identified along its route by traffolyte cable markers, in accordance with the Sub-Contractor’s cable schedule.

7 **PART G: LIGHTNING PROTECTION SYSTEM**

7.1 **Scope of Work**

Under this section of the Specification the Sub-Contractor shall supply, deliver and install a lightning protection system as shown on the Contract Drawings.
The installation shall comprise of down conductors of 25x3mm flat copper tape drawn in 32mm diameter surface conduits with a provision for a test point.

The Sub-Contractor shall include for the supply and installation of the roof tape network, all bonding to down conductors and other metal works and earthing as indicated on the appropriate drawings.

7.2 Description of Installation

The installation is based on the recommendation of British Standard Code of Practice C.P. 326: 1965 and shall comprise a network of 25mm x 3mm flat copper roof tapes and copper tape down conductors in 32mm diameter conduits.

7.3 Bonding to Roof Tapes

The roof tapes shall be fixed into the roof by means of special holdfasts. All roof tape tanks and other metal work projecting from the roof shall be bonded to the roof tapes and form part of the air termination network. In addition all metal within 2m of the network should be bonded to the network.

No part of the roof shall be more than 10m from the nearest horizontal conductor. A lightning arrester shall be placed on all aerial service conductors.

All bonding shall be fixed simply, solidly and permanently. The system shall have as few joints as possible and such joints as are necessary shall be mechanically and electrically sound. Overlapping joints shall not be less than 20mm for all sizes of conductor.

7.4 Bend and Loops

Bends in down conductors in excess of $60^\circ$ and re-entrant loops shall be avoided.

7.5 Earthing

The whole of the protective system shall have combined resistance to earth not exceeding 10 ohms. Should the values exceed 10 ohms, reduction in resistivity shall be achieved by linking earth electrodes below ground.

Each down conductor shall be provided with a testing joint in such a position that while not inviting unauthorised interference, is conveniently situated for testing.

Earth electrodes shall be situated at least 1m from foundations.

The earthing network for the lightning protection system shall be bonded to the switchboard’s earthing system in the various blocks.

7.6 Continuity Tests

The entire networks shall be tested for continuity including the testing of each down conductor.
PART H: EXTERNAL/SECURITY LIGHTING

7.7 Power Supply

Power supply shall be derived from a consumer unit to be located on ground floor and controlled via a contactor and a time switch, and incorporating bypass switches.

External and security lighting shall be controlled via appropriately rated contactors. Each contactor shall incorporate an over-riding manual switches for used in event of contactor failure.

7.8 Security Lighting Poles

The security lighting pole shall be made of galvanised steel as per the contract drawing. The pole shall be installed at a depth of 825mm in the ground on a 75mm thick concrete foundation. Heights of the poles shall be as described on the contract drawings.

Doors giving access to the mounting plate for cut-outs shall be weather proof, and provided with a locking device.

The pole shall be electrically continuous and shall be provided with an easily accessible corrosion resistant earth terminal having substantial contact surface for attachment on an earthing lead.

After manufacture and before erection, the columns shall be treated with an approved mordant solution, which shall be brushed off, and the whole allowed to dry. Thereafter, the columns shall be treated with one coat of leylac and two coats of gloss paint to a colour to be approved by the Engineer. A sample of the column shall be availed to the engineer for approval before fabrication commences.

7.9 Lanterns

Security lighting lanterns shall be of the completely enclosed type, with anti-vandal spheres designed with integral control gear and shall be capable of accommodating a single 100 watts metal halide lamp. The lighting lantern shall be of the type and manufacture as detailed in the schedule of luminaries, Appendix II.

7.10 Spacing and Sitting

The street lighting poles shall be in the positions indicated on the contract drawing. Slight variations in sitting to allow for conditions on site may be permitted on site, but these shall be subject to prior approval by the Engineer. The spacing between lighting columns shall be 20M.

7.11 Cable Laying

The cables shall be 600/1000V pvcswapvc with copper conductors as indicated on the contract drawings. All cables shall be terminated with brass glands of suitable size to maintain proper earth continuity throughout the system. Cables shall be taken into lighting columns through service entries below ground. The loop in arrangement from the poles shall be through suitable lucy connectors mounted in the pole windows.
Galvanised armour wires shall be properly earthed and, to maintain earth continuity, earth clips and connectors shall be used. From the cut out to the lantern 1.5 mm sq. pvc insulated and sheathed twin with earth cables shall be used. The lantern shall be earthed separately.

In general, the installation shall conform with the requirements of Part B of this specification. The cables shall be laid at a depth of 750mm.

7.12 Road Crossings

Cables crossing carriageways and under buildings shall be laid in 100mm diameter pvc ducts at a depth of 600mm. The crossings shall be as short as possible and the ducts shall extend 4.5m beyond the carriageways. The ducts shall be installed by the Main Contractor. The Sub-contractor shall ensure that the ducts are installed to his satisfaction.

7.13 Cable Trenches

Trenches for underground cables shall be excavated to a depth of 600mm. Where ducts are not used, cables shall be laid on a stone free bed of sand or sifted soft soil not less than 75mm deep and surrounded and covered by a further 75mm of sand or sifted soft soil. Protection tiles or slabs of concrete inscribe HATARI and to BS 2484 shall be laid over the cables so as to provide an overlap of 50mm on each side. The trenches shall be backfilled, the earth rammed down and leveled. Any surplus material shall be removed from the site. The cable trenches shall be dug and backfilled by the Main Contractor.

7.14 Cable Bending

In the laying of pvc swa pvc cable, the minimum internal radius of the bend shall be six times the overall cable diameter.

7.15 Cable Jointing

No jointing shall be permitted in cable runs, and the supply throughout shall be by looping of cables from terminal to terminal, using loop-in/loop-out cut-outs in the column windows.

7.16 Cable Sizes

Cable sizes have been indicated on the contract drawing and the Bills of Quantities. The cable sizes have been chosen to provide adequate current capacity and acceptable voltage drops of a maximum of 2.5% of nominal supply voltage.

7.17 Cable Terminators

Suitably sized cable compression brass glands, type BW to BS 6121:1173 complete with pvc shrouds shall be used for terminating all ends of pvc swa pvc cables.
7.18 **Route Markers**
Cable makers shall be installed to indicate routes of all cables laid direct in the ground. These shall be placed at all change of direction and at intervals of approximately 50M on long runs. These shall also be used to indicate the positions of underground ducting.

The makers shall be made of cement concrete (class 20) and dimensional 20mm + 600mm. A moulded inscription “CABLE” shall appear on the top phase, which shall be left protruding 300mm above ground.

7.19 **Mcbs**
For local protection of the lanterns 5A Mcbs shall be installed on the mounting-plate in the pole window.

7.20 **Earthing**
The lighting column, bracket and lantern shall be electrically continuous and earthing continuity between consumer unit and lighting columns shall be maintained via the steel wire armour of the underground cables which shall be electrically bonded to the metal work of the columns and pillars by means of compression glands at cable termination.

Lighting columns shall each have easily accessible, amply proportioned and corrosion resistant earthing terminals.

In addition to the electrical continuity of column and lantern, a copper earth wire shall be connected between the forming part of 2.5mm² twin-core and earth PVC/PVC cable run from the cutout to the lantern.

Every second lighting column shall be efficiently and solidly earthed using earth-rods driven vertically into the ground as near to the earthing terminals as practicable.

Earth rods shall be of extensible type, made of 15mm diameter steel-cored copper provided with a steel point at the lower end and a steel driving cap and heavy duty earthing clamp at the upper end.

The number of rods to be used at each earthing position shall depend upon the site earthing resistance obtained which shall not exceed 0.5ohms.

Earth leads shall be insulated, 4mm² minimum, and protected against mechanical damage where necessary. The leads shall be soundly connected to the earth clamps and the connections painted over with bitumen.

7.21 **Testing of the Installation**
After completion and before commissioning, the entire installation shall be subjected to the following tests and any faults found shall be rectified.

(a) **Polarity:**
All fuses and control devices shall be connected in live conductors only.

(b) **Insulation Resistance:**
When tested with a 500 V.dc. supply the insulation resistance between conductors of live lines, lines and neutral, line and earth, neutral and earth shall not be less than 1 megohm.
(c) **Earth Continuity Resistance:**

Resistance of earth continuity measured from a consumer unit to the farthest end of a circuit shall not exceed 0.5 ohm.

7.22 **Testing and Commissioning**

Testing and commissioning shall be carried out in accordance with Section B of this specification. All tests shall be carried out in the presence of and to the certification of the Engineer.

8 **PART I: FIRE DETECTION AND ALARM SYSTEM**

8.1 **SYSTEM OVERVIEW**

8.1.1 **Type of System**

The system shall be operable manually and automatically and shall be suitable for protection of life and property. It shall cover those parts of the building where there is a high risk to life in event of a fire anywhere in the building.

The system shall be of the Analogue Addressable type, with **Continuous** monitoring of analogue quantities and automatic adjustment of Alarm Threshold, designed in accordance with this Specification. The system shall allow continuous monitoring of data from the detectors by the control panel and shall be able to identify callpoints, detectors and interface units and pin-point sounders, repeat and mimic panels if any. The system shall be based on **the principle of central processing**.

**Microprocessor systems** shall be of modular design and consist of suitable standardized hardware and software packages. It shall thus be possible to expand and modify systems in future easily and without tampering with the existing working modules. In addition software routines shall be designed to provide automatic restart after power failure etc., so that the system will become fully operational without manual intervention. The main operating system, system configuration data and monitoring software shall be contained in battery-backed ROM, may be left in the ROM or automatically copies into the RAM area on booting up. Field-programming shall be carried out by means of fixed or plug-in keyboards or by hand held computers. The user data shall be safe-guarded by permanently fixed Lithium batteries or by storage in EPROM's.

The capacity of the data-processing system shall include 25% spare capacity.

8.1.2 **Data Transmission**

The communication faults shall be announced on both sides with transmission errors being indicated on the fire panel. Such faults shall not lead to deterioration of the Fire Panel Operation.

Transmission errors detected by a receiver shall deny acknowledgement of the message and request repetition by the sender. Receipt of three consecutive errors shall result in the fault message being displayed at the fire panel.
The system shall incorporate means for monitoring and circuit isolation complying with this specification.

8.1.3 **Zoning**

The zone divisions and associated circuiting shall comply with BS 5839. The complex shall be divided into 23 zones as specified.

Where cable loops are specified, each leg of cable between the Control Panels and the first device enroute shall pass through different zones as soon as practicable after leaving the panel.

A single fault in any zone shall not prevent the operation of other zones and shall not remove protection from areas greater than permitted by this Specification.

Equally a single short or open circuit fault on any part of the loop shall not cause system malfunction, loss of operation, power or ability to report an alarm in the unaffected areas.

8.1.4 **Training**

The Tenderer shall allow for the training of two of the Client’s Technicians to a level where they are sufficiently confident and proficient in managing, trouble-shooting and maintenance of the system including programming of the system and devices as desired.

8.1.5 **Standards and Regulations**

The design, manufacture, selection, installation, testing, commissioning and subsequent maintenance of all equipment and materials described in this Specification shall comply with the requirements of:

- The current editions of BS 5839, BS 5445 and BS 5446,
- The current editions of EN54,
- The current editions of BS 5266, BS 2560 and BS 5499.

All equipment, apparatus and devices shall be as Menvier, GE Security (Aritech) or equivalent and approved.

8.2 **System Operation**

8.2.1 **Access Codes**

The system shall be designed to operate at 4 security levels, as follows:

<table>
<thead>
<tr>
<th>Level</th>
<th>Access Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>No access Code-operator</td>
</tr>
<tr>
<td>Level 2</td>
<td>Access Code – Maintenance</td>
</tr>
<tr>
<td>Level 3</td>
<td>Access Code – Commissioning</td>
</tr>
<tr>
<td>Level 4</td>
<td>Access Code – Supervisor</td>
</tr>
</tbody>
</table>

Access codes shall be allocated and entered into the panel by the Supervisor, who shall have the ability to change codes at any time. Facilities must be provided for entering operator names against each access code.
8.2.2 **Operation**

The system shall be designed to operate with the minimum of operator training. Basic fire alarm functions shall be completely self-explanatory, and shall be understood by a person with no training.

The occurrence of a fire alarm shall indicate all relevant text and zone information without operator intervention.

The operation of a fire or fault signal, or a keyboard operation carried out by an operator, shall not inhibit or delay in any way the receipt of additional alarms.

Should any part of the system be isolated, disabled, or placed in a maintenance mode, then a lamp on the front of the panel must illuminate to indicate the system's abnormal status.

When the system is normal with no event to report, the main control panel LCD shall display time and date, the name of the site, make and model of the system control equipment.

8.2.3 **Fire Operation**

An alarm received from a fire sensor or other device shall cause the following actions to occur immediately:

- Common Fire lamps to illuminate
- Zone/Superzone lamp to illuminate
- The LCD display shall indicate in text the following:
  - The zone
  - Device type
  - Actual location and address
  - Event number
  - Date
- Panel buzzer to sound continuously
- Common sounders to operate in a pre-determined manner.
- Zone sounders to operate (if applicable)
- Required control functions to operate
- Remote text or lamp displays to operate
- Graphics computers to indicate alarm status
- Fire Brigade signal to operate.

Pressing an appropriate key shall silence the alarms, except the panel buzzer, which must sound intermittently for 0.5 second, every 20 seconds.

Pressing the “Reset” button shall reset the system to normal. Should an alarm condition still exist, then the above sequence of events must re-occur.

8.2.4 **Fault Operation**

A fault signal received from a fire sensor or other device, or from the panel or battery charger, shall cause the following to occur immediately, where appropriate:

- Common Fault lamps to illuminate
- Zone/superzone lamp to illuminate
- Display to indicate in text:
  - FAULT DESCRIPTION
  - Zone Number
  - Detector Number
  - Exact Location

- Panel buzzer to sound continuously
- Required control functions to operate
- Remote text or lamp displays to operate
- Graphics computers to indicate alarm status.

Pressing an appropriate key shall silence the alarms. The visual alarms are to remain. In the event of more than one fault signal occurring simultaneously, then the test display must rotate between the alarms.

Should a fire alarm occur while a fault is displayed, then the fire alarm must replace the fault signal, which must restore after the fire alarm has reset.

Pressing the “Reset” key must reset the system to normal. Should a fault condition still exist, then the above sequence of events must re-occur.

8.2.5 **Key Features of the System:**

- 23 Zone L.E.D. indication with facilities to expand display if required.
- Alphanumeric 8 line 40-character liquid crystal display.
- Integral printer.
- An Amber system common “fault” L.E.D. indicator with individual Amber L.E.D.’s for the following:
  a) Pre-alarm
  b) Disabled devices/loop/alarm lines.
  c) System test.
- Push button control of Sound Alarms, Silence Alarms, with L.E.D. indication and Reset.
- A manual evaluation (sound alarms) push button shall be provided to operate the external sounders without causing other panel control relays to be activated. However, should a true alarm occur, all functions would occur as programmed.
- The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit.
- System control access shall be limited by programmable 4-digit numeric security code.
The system shall operate on 24 volts DC provided by power supply unit, which is transformer, fed by mains voltage. In the case of mains failure, the system shall switch automatically to the stand-by batteries. These shall have enough capacity to support the system for 24 hours with 30 minutes of general alarm ringing.

It shall be possible to increase this to 72 hours with 30 minutes of general alarm ringing if required.

The batteries shall be monitored for low battery condition/disconnection and shall be audible and visually indicated on the control panel.

- Each loop shall be capable of driving up to 120 addressable devices over a maximum loop distance of 2 km.

- The system shall be capable of providing alarm and relay extensions, which can be connected at any address on the loop thus eliminating the need to wire directly from the panel. All extensions should be fully programmable via the control panel software.

- All external circuits shall be monitored for open circuit, short circuit and fuse failure.

- Loop address locations shall be monitored for device type fitted and any deviations from programmed allocation visually and audibly indicated.

- Loop address locations shall be monitored for device removal.

- System shall have a minimum of 2 independently monitored alarm lines per loop.

- It shall be possible to disable/enable individual devices, zones, loops and alarm lines for maintenance purpose.

- Panel shall have the facility for 1 man test mode. In this mode, external alarms will sound for 3 seconds then reset and give 3-second alarm to indicate reset has taken place. Each device test shall be indicated on Control panel printout as a test activation.

- It shall be possible to view the Analogue level of each detector from the control panel without initiating an alarm.

- Panel shall have Dirty Detector and Pre-alarm facilities with adjustable pre-alarm and full alarm thresholds.

- The system shall have day/night facilities to provide an esensitized level of detection programmable to clients’ requirements.

- The system shall be capable of onsite programming to accommodate system expansion and facilitate changes in operation.

- All software operations shall be stored in non-volatile programmable memory within the control panel.

- Loss of primary and secondary power shall not erase the instructions stored in memory.
• The system shall have the capability of recalling alarm and fault conditions in chronological order for the purpose of creating an event history.

• Should a fault condition be present an audible fault buzzer will sound. If silenced; the buzzer will resound at pre-programmed time intervals to act as a reminder that the fire alarm system is not fully functional.

• The control panel shall have 2 x R.S. 232 ports to allow programming and connection to ancillary equipment.

• The Control panel shall have facilities to operate repeater/mimic panels from a dedicated output and also capable of supporting repeater panels wired directly on the loop.

• It shall be possible to network analogue panels to give configuration of 24 loops.

• All panels and peripheral devices shall be the standard produce of a single manufacturer.

8.2.6 **History Recording and Reporting**

The AACIE shall contain a history buffer that will be capable of storing input/control events. Each of these events will be stored and time and date stamped with the actual time of the activation. The contents of the History Buffer may be manually retrieved, one event at a time, on the LCD or the printer.

The History Buffer shall use non-volatile memory. System that uses volatile memory or battery-backed memory for history storage shall not be acceptable.

8.3 **SYSTEM COMPONENTS**

The system shall comprise of but not restricted to the components outlined below:

8.3.1 **Annunciator and Control Panel**

The Control Panel shall incorporate a QWERTY keyboard and printer, fire indicator, user instructions and controls, power indicator, warning indicator, fault indicator, function keys, liquid crystal display (LCD) with automatic backlighting and integral power supply system.

The fire alarm control panel shall be mounted on the wall. The cabinet shall be made of sheet steel, with lockable door, viewing panel and solid state microprocessor based electronics.

The main annunciator/control panel shall be located at the Ground floor entrance lobby.

8.3.2 **Repeat Panels**

The Repeat Panels shall be capable of annunciating the same information as the main control panel.

8.3.3 **Mimic Panels**
Provision shall be made for possible installation of mimic panels in the future.

8.3.4 **Duct Detector**

This shall be used in ventilation ducts and shall be analogue addressable optical/heat detectors.

8.3.5 **Detector Base**

These shall be used to mount the analogue addressable detectors and shall be either 2-way or 3-way incorporating an LED connection.

8.3.6 **Interface Units**

These shall be used to interface the fire detection and alarm system with remote sites and devices such as the fire brigade, firefighting systems etc.

8.3.7 **Printer**

The control panel shall incorporate an inkjet printer with an audible signal for end of paper and fault.

The printer shall be the automatic type, printing time, date, location, device description, category and condition. The printer shall provide a hard copy print out of all changes in status of the system and shall time stamp such minutes with the current time of day and date. The printer shall be incorporated in the main analogue addressable control and indicating equipment (AACIE) housing.

8.3.8 **Break Glass Unit**

The break glass unit shall be mounted at a height of 1350mm from FFL and shall be suitable for flush mounting. The break glass unit shall be addressable with an LED indicator incorporated as standard to confirm that the unit has operated.

8.3.9 **Heat Sensors**

The heat detector shall be analogue intelligent addressable type capable of being configured by the control panel to operate as a rate of rise heat detector. The base shall be lockable and common with that of the smoke detector. It shall also incorporate a fixed temperature element operating at a predetermined temperature.

8.3.10 **Smoke Detector**

The smoke detector shall be analogue addressable optical type with in-built processing capacity. The base shall be lockable type and common with that of the heat detectors.

8.3.11 **Electronic Sounder**

The sounder shall be weatherproof type, suitable for 24V DC, low current consumption with high output.

8.3.12 **Visible Flash Light**
The unit shall be weatherproof type, suitable for 24V DC, low current consumption with high visible flash light.

8.3.13 Fire Door Holder

8.3.14 Fire Remote LCD Display unit

8.3.15 Short Circuit Isolators

Short circuits isolators shall be provided to protect loop integrity in the event of a short circuit fault occurring on the loop. They shall latch out either side of the short circuit fault, effectively disconnecting the faulty cable.

The short circuit isolator shall have an indicator LED visible throughout the front cover, which will illuminate when latched out due to short circuit cable fault.

The loop should be divided into sections not greater than a conventional zone and each section of the loop separated by a short circuit isolator, to a maximum of 20 per loop.

8.4 SOFTWARE CONTROL

8.4.1 General

The System shall at all times be under software control. Two types of software shall be provided, the operating programme and the configuration programme.

8.4.2 Auto Configuration

Upon switch-on, the panel shall, automatically and without manual intervention, programme itself to operate as follows:

1. Be fully functional (Fire and Fault)
2. All device addresses present to be recorded in memory
3. All device types to be recorded in memory
4. Devices to be automatically calibrated.
5. Common fire lamps must operate
6. Common sounder outputs (2) must operate
7. Common fault output must operate
8. Display must operate

8.4.3 Manual Programming

Additional configuration data, to tailor the system to the individual application, must be able to be programmed into the system. This programming must be able to be done both via the panel keypad, and by means of an external computer. In both cases it must be possible to save the programme to disk.

8.4.4 Storage of Software

All software, both the operating programme and the configuration data, shall be held in solid state memories. In particular, software shall not be held on magnetic tapes or discs, or any device requiring mechanical moving parts.

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8.4.5 Operating Programmes

The operating programme must be held in permanent, non-volatile, read-only, EPROM memory, which shall not be erasable or alterable. Each EPROM shall be permanently labelled with a part number, and a version and issue number, which shall be traceable to a software manual.

The operating programme shall provide all auto-start and self-programming features to provide an operational system, without any manual programming, as described above.

8.4.6 Configuration Data

All configuration data shall be stored in non-volatile, EEPROM read-only memory, which can be electrically erased for editing purposes. The EEPROM used must retain all programmed data, even when the system is completely powered down.

Printed circuit mounted batteries, such as lithium cells, for retaining memory contents, are not acceptable.

All configuration data must be able to be edited through the keyboard.

8.5 CONTROL AND INDICATING EQUIPMENT

8.5.1 General

Equipment shall be provided for the reception, indication, control and relaying of signals originating from detectors or call points connected to it and for the activation of alarm sounders, signalling devices and transmission/receipt of signals to/from remote locations.

Control panels shall be of modular design employing plug-in cards allowing future expansion and tailoring of detection zones and outputs to meet the Engineer's requirements.

Where plug-in zone modules are used, these shall operate independently of other zone modules.

Operation of the control panel in case of alarm or fault shall be achieved by simple guided instructions with visual indicators on the control buttons.

It shall be possible to set any zone to test mode for testing of detectors and call points without raising an alarm condition. It shall also be possible to test sounder circuits, by operation for one second and off for 10 seconds, repeated for as long as required.

Monitoring of detection and alarm circuits shall be provided in accordance with BS 5839.

In all systems the electrical power for operation of detectors shall be provided through the loop circuit wiring.
8.5.2 Main Annunciator/Control Panel

The Main Annunciator/Control Panel shall consist of a Central Processing Unit, Fail Safe Power Supply Unit, a QWERTY keypad, an Alphanumeric LED Display, a printer, a Fire Indicator, Essential User Instructions & Controls, Power Indicator, Warning Indicator, Fault Indicator and Function Keys.

The Control Unit shall operate on 240 Vac, -15% to +10% 50Hz. mains power.

The panel shall be suitable for 2 loop circuits serving 4 zones.

The control unit shall be located at the Main Security Control Room at the Upper Deck Offices.

8.5.3 Central Processing Unit Software

The Central Processing Unit shall monitor and supervise the total fire alarm system. All system configuration and operation functions shall only be accessible via password to System Engineers.

All system incidents and alarms, operator interventions and uses of passwords shall be logged chronologically in a system history file for review by the system user and system engineer. A minimum of the last 20 events shall be recorded.

The software packages must be standardised and proven in operation. Customer designed or project oriented software will not be accepted.

8.5.4 QWERTY Key Pad

A QWERTY Key Pad shall form part of the fire alarm control panel to allow device labelling and system engineering.

8.5.5 Alphanumeric LED Display

The Display Unit shall display system and user text messages to indicate alarm, change of status, operation functions and location of origin of signals.

System text shall only be accessible for editing by the systems engineer and shall include:

- Description of alarm locations and device (e.g. Zone 1, Level 2)
- Advice for editing User Text.

User text shall include:

- Description of each zone
- Special operator advice and counter actions to be taken (e.g. press alarm acknowledge button and send fire investigation squad).

The Contractor shall submit schedules of system and user text to the Engineer for approval.
8.6 DETECTORS, CALL POINTS AND SOUNDERS

8.6.1 General

It shall be possible to connect and mix manual call-points and automatic detectors within the same zone irrespective of the operating principle.

Detectors shall be of the plug-in type, the insertion and removal of which requires a push and twist action, unless otherwise specified.

Detector bases shall be of a standard type allowing any point type detector to be plugged into any base.

Standard bases shall be equipped with clamp type wiring terminals. The cable entry shall have a grommet type seal which is a tight fit around the wires. Removable dust covers shall be provided to protect the detector contacts until these are fitted. Once inserted the detector shall be securely held in place so that it cannot become loose when subject to vibration.

The Contractor shall provide special tools required for the dismantling of detectors for periodic cleaning in accordance with the manufacturer’s instructions.

Detectors shall not be damaged by reversed polarity.

Detectors shall include built-in alarm indicators and provision shall be made for the connection of remote visual indicators where required.

Remote indicators shall be provided where detectors are normally concealed from view. The indicators shall be labelled to show the location of the corresponding detector.

Detectors shall have acceptable built in screens to prevent the entry of insects.

Where detectors are mounted at heights exceeding 3m above finished floor level the Contractor shall submit proposals for the testing and exchange of detector heads.

Master Slave arrangements shall not be used.

8.6.2 Manual Call Points

Manual call points shall have normally open (N/o) contacts and be electrically compatible with the automatic detectors used.

Manual call points shall comprise baseplate, insert and cover and be suitable for fixing to standard switch boxes of purpose surface mounted type of the same colour.

C/50
Covers shall be red in colour and of the snap-on type secured against unauthorised removal. It shall be possible to test the call point without breaking the glass or removing the cover.

All inscriptions shall be permanently made on the cover and not on the glass.
Call points shall employ acceptable sealed micro switches.

The alarm condition shall be maintained until reset by an authorized person by means of a special tool provided for that purpose.

Manual call points installed in areas where scattering of fragments of the frangible glass would be a problem, shall utilize frangible elements the broken pieces of which are contained within the cover of the call point. Call points provided in food preparation areas shall not utilize frangible glass.

8.6.3 Audible Alarms

Fire alarm signals shall be initiated in accordance with the agreed Fire Routine.

Audible alarms shall be fully co-ordinated and shall be clearly distinguishable from other audible warning devices.

Each sounder shall be suitable for the system voltage and with low power consumption up to a maximum of 15w.

Alarm sound levels shall not be less than 65dB(A), and all levels shall be a minimum of 5dB(A) above any background noise level which occurs for 30s or more.

The maximum alarm sound level in any occupied area shall not exceed 120dB(A).

The maximum energy output of Fire Alarm signals shall be in the frequency range of 500Hz – 1kHz.

The Evacuate Signals shall comprise of an uninterrupted sound.

One unique sound shall be produced by all Fire Alarm sounders. Mixed devices shall not be permitted unless these produce aurally indistinguishable sounds.

8.6.4 Workmanship

The installation and method of fixing of all devices covered by this section of the Specification, shall be co-ordinated with the building fabrics and finishes to which they are fixed.

All devices covered by this section of the Specification, shall be fixed true and level to the surfaces on which they are mounted to a tolerance of ±5mm.

Under no circumstances shall Detectors and Alarms be fixed to temporary or movable parts of the building fabric, including doors and furniture.

8.7 INTEGRATION WITH OTHER SYSTEMS

8.7.1 General

The Fire Alarm system where required shall be integrated with associated and ancillary systems. These shall include lifts, Nurse Call, Public Address, Master Clock, Security System, sprinkler system, HVAC System.
Ancillary equipment shall be equipped with means of isolation and disabling of Automatic operation so that servicing and maintenance can be carried out in complete safety.

Unless otherwise specified, power supplies for associated and ancillary equipment shall be provided by means completely independent of the Fire Alarm System Power Supply. These power supplies shall comply with this Specification where their operation is essential to the functions of the Fire Alarm System.

Indicators and detectors associated with ancillary equipment shall be taken into account in calculating the maximum load of the Fire Alarm System power supply.

Faults in equipment for other functions shall not affect the performance of the Fire Alarm System.

Extension and alterations to associated systems including the isolation and removal of parts, shall be possible without affecting the operation and performance of the Fire Alarm System.

8.7.2 **Interface Units**

Interface units shall be provided to send signals to and receive signals from associated and ancillary systems. Unless otherwise specified, all signals shall be via volt-free relay contacts.

The volt-free relay contacts shall be provided by means of addressable input and output modules of the fire alarm detection loop, each module representing a single address.

Addressable input and output modules shall be compatible with the system to which they are connected, and shall be of the type that draw their power supply from the detection loop.

Contacts shall have a minimum rating of 5 Amp inductive at 240V a.c.

**The Sub-Contractor shall be responsible for the interface and all wiring and connections between interface units and the system to which they are being interfaced.**

8.7.3 **System Requirements**

Fire alarms in integrated systems must always take priority over all other systems and must not be delayed in operation by any manual or automatic event.

The layout of control panels in integrated systems shall be arranged so that Fire Alarm controls cannot be confused with other controls.

Operation of other system controls shall have no effect on the operation of the Fire Alarm System.

8.7.4 **System Monitoring**

All wiring systems for communications, detection and alarms shall be monitored for open and short circuits, removal of detectors as well as Alarm/Healthy conditions.
All faults shall be registered by audible and visible fault alarms, the latter being yellow
coloured LED’s.

Alarms due to system fault as opposed to a fire condition shall be restricted to the panel
buzzer only.

8.7.5 Wiring Systems

The Contractor shall be responsible for the supply, installation, testing and commissioning
of all the wiring/cabling systems required to provide a complete and operable system.

All wiring shall be in highly durable fire resistant cables as Pirelli FD200 complying with
IEC 331, BS 6387, IEC 1034, BS 7622, IEC 754 – 1, BS 6425 – 1, IEC 332 – 1, BS 4066
– 1, IEC 332 – 3 and BS 4066 – 3. Cables shall be drawn in high impact heavy gauge pvc
conduit installed in ceiling spaces, chased into walls or cleated onto surfaces and shall be
routed through areas of low fire risk.

Voltage drops in cables shall not exceed the limit which will prevent devices operating
within their specified range at all times.

Cross-sectional area of any conductor shall be at least 1.5mm$^2$.

Overhead lines shall not be used for any Fire Alarm System Interconnections.

The routing of cables shall be arranged so that damage to a cable in a single compartment
does not affect the correct operation of devices in any other compartment.

Conductors carrying fire alarm power or signals should be separated from conductors used
for other systems.

Cables should be installed in accordance with good practices recommended in the latest
edition of the IEE Wiring Regulations.

8.8 POWER SUPPLIES

8.8.1 General

Power supplies shall be obtained from the 415/240V 50Hz, single or three-phase mains
supply with a backup from an automatic connected battery powered standby supply
provided by the Contractor in case of mains supply failure.

The mains supply shall be obtained from the main distribution panel at the point of supply,
via an acceptable switch/fuse, fuse/switch or circuit breaker dedicated for that purpose
and which is lockable, coloured red and labelled ‘FIRE ALARM SUPPLY DO NOT
SWITCH OFF’.

A fault alarm shall be raised if the battery voltage falls below 84% of the nominal specified
voltage.

Upon restoration of the mains supply following an interruption, the power supply shall
automatically revert to normal operation.
8.8.2 Batteries

Batteries shall have a guaranteed minimum life expectancy of 10 years, under the specified loading and environmental conditions.

The batteries used shall be of the sealed gas-tight lead-acid type specifically designed for emergency power sources and complying with the relevant standard. The outer container shall be made of acid resistant high impact strength ABS plastic. The electrodes shall be of high purity lead separated by a gel electrolyte enabling full recombination of gases evolved during charging. An automatic safety valve shall be provided.

Each battery shall have a storage capacity sufficient to maintain the system plus 20% spare capacity for 72 hours in the standby mode and to supply the full alarm load for one hour, without the terminal voltage falling below 84% of its nominal value.

8.8.3 Battery Chargers

Battery chargers shall comply with this Specification and be suitable for operation from 415/240V 50Hz, single or three phase systems as required.

The battery charge shall be of the automatic two-rate constant voltage type operating of the float charging principle. The charge shall be designed to compensate for variations in ambient temperature in accordance with this Specification.

 Provision shall be made for a boost charge, under manual control, at a current sufficient to fully recharge a completely discharge battery in not more than 24 hours.

The battery charger shall have a monitoring system connected to the Fire Alarm panel which will raise an alarm in the event of a battery and/or charger fault or malfunction.

The monitoring system shall raise an alarm if the battery voltage falls to 84% of its nominal value and if the voltage falls to 80% of the nominal value the battery shall be automatically disconnected.

The transformer shall be double wound with an earthed metallic screen between primary and secondary windings, which shall be wound for the specified voltage, rating and supply system frequency.

8.8.4 Enclosures

Each battery and its charger shall be housed in a substantial steel cabinet or cubicle with the battery in a separate compartment.

Cabinets with a total installed weight not exceeding 25kg shall be wall mounted.

The Contractor shall ensure that the wall and/or floor supporting the cabinet or cubicle is adequate for the purpose.

Enclosures shall be rigidly constructed from zinc-coated sheet steel, stiffened by folding or reinforcement. The sheet shall not be less than 914mm thick for wall mounted
enclosures. After thoroughly degreasing all enclosures shall be finished with an oven baked epoxy powder paint.

The interior surfaces of the battery compartment shall be treated with an acid and alkali resisting finish.

Access to the enclosures shall be via an easily accessible door with adequate space for replacement of batteries and any other parts of the charger. Doors shall be double hinged and stiffened to ensure adequate rigidity.

The batteries and charger components shall be arranged for ease of access and any maintenance required.

Warning labels shall be provided drawing attention to the presence of mains voltages. Incoming and outgoing cables shall be specially separated.

Enclosures shall be suitably ventilated to ensure proper ventilation of both the battery and charger compartments. The ventilation system shall be arranged to ensure that the concentration of Hydrogen within the enclosure shall not exceed 1% and that the internal temperature does not exceed 40°C.

### 8.8.5 Workmanship

The installation of power supply equipment, shall be fully co-ordinated with the Fire Alarm Control Panels, building fabrics and finishes provided by others, in an acceptable manner.

The method of fixing and the mounting height of flush and surface mounted power supply units, shall be properly coordinated with the fabrics and finishes.

Provision shall be made for the easy entry and termination of incoming and outgoing cables.

All power supply units shall be fixed true and level to the surfaces on which they are mounted with a tolerance of ±0.5mm.

### 9 PART J: SPECIALIST WORKS

#### 9.1 Scope of Works

This section of the specification covers the supply and installation of conduits, cable trays, trunking systems, draw and adaptors boxes underground ducts and lead pipes necessary for the distribution cables in accordance with the contract drawings and specifications for the following specialist services:

- Security Systems
- Telephone Systems
- Generator Installations
- Mechanical Services Installations
- IPTV Systems
- Master Clock Installations
- Nurse Call System Installations
- BMS
- Public Address system
- etc.

All conduits shall be adequately sized to suit system and shall be complete with draw-wire. Conduits less than 25 mm dia shall not be acceptable.

9.2 Attendance

The Sub-Contractor shall allow for attendance to the respective specialist in the appropriate price schedule of the Bills of Quantities.

The equipment for the above systems shall be supplied by others under separate Sub-Contractors.
PART K

PRICE SCHEDULES
10 PART K: PRICE SCHEDULES

10.1 GENERAL NOTES TO TENDERERS

1. The Bills of Quantities form part of the contract documents and are to be read in conjunction with the contract drawings and general specifications of materials and works.

2. The prices quoted shall be deemed to include for all obligations under the sub-contract including but not limited to supply of materials, labour, delivery to site, storage on site, installation, testing, commissioning (excluding 16% VAT).

3. All prices omitted from any item, section or part of the Bills of Quantities shall be deemed to have been included to another item, section or part thereof.

4. The brief description of the items given in the Bills of Quantities are for the purpose of establishing a standard to which the sub-contractor shall adhere. Otherwise alternative brands of equal and approved quality will be accepted.

5. Should the sub-contractor install any material not specified here in before receiving written approval from the Project Manager, the sub-contractor shall remove the material in question and, at his own cost, install the proper material.

6. The grand total of prices in the price summary page must be carried forward to the volume 1.

7. The Bills of Quantities are divided generally into three sections:

   a. Contractual Requirement – Bill 1

      The sub-contractor shall study the conditions and make provision to cover their cost in this Bill. The number of contractual items to be priced by the Tenderer have been limited to tangible items such as site office, temporary works and others. However the Tenderer is free to include and price any other items he deems necessary taking into consideration conditions he is likely to encounter on site.

   b. Installation Items – Other Bills

      The brief description of the items in these Bills of Quantities should in no way modify or supersede the detailed descriptions in the contract Drawings, conditions of contract in volume 1 and specifications. The unit of measurements and observations are as per those described in the contract documents.

   c. Summary

      The summary contains tabulation of the separate parts of the Bills of Quantities carried forward with provisional sum, and any prime cost sums included. The sub-contract shall insert his totals and enter his grand total tender sum in the space provided below the summary.

      This grand total tender sum shall be carried forward to main summary of volume 1 of the main works.
### SECTION D.W. 1.0 TITLE: PRELIMINARIES & CONTRACTUAL REQUIREMENTS

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<td>(c) Operational Instructions, manuals and test certificates</td>
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Total Carried to Main Summary Page
## SECTION D.W. 2.0 - INCOMING ELECTRICITY SUPPLIES

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<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.W.2</td>
<td>INCOMING ELECTRICITY SUPPLIES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>Allow a P.C. Sum of <strong>KShs.17,000,000.00</strong> for the capital contribution towards Kenya Power &amp; Lighting Co. Ltd.’s supply line, H.T. gear, metering panel and connection charges.</td>
<td></td>
<td></td>
<td></td>
<td><strong>17,000,000.00</strong></td>
</tr>
<tr>
<td>B.</td>
<td>Contractor's charges for attendance to the Kenya Power &amp; Lighting Co. Ltd.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>Any other items to complete the installations in this section.</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Total carried forward to Main Summary of Prices
## SECTION D.W. 3.0 - MEDIUM VOLTAGE EQUIPMENT

<table>
<thead>
<tr>
<th>Item</th>
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<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.W.3</td>
<td><strong>Medium Voltage Equipment</strong> Supply, installation, testing and commissioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>of the following complete as specified. All cables shall be copper and shall</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>be complete with cable glands, lugs and necessary termination kits.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>Supply, Install, Test and Commission of 11kV Metering switchgear labelled,</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Client's Metering Panel &quot;2&quot; complete with 5no. SF6 filled circuit breakers,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>feed units, busbar, CTs, Dual Tariffs Energy Meter, BMS interface points as</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>specified and shown on the EP _3 and EP _4.1 drawings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>Supply, Install, Test and Commission of 95mm² 3C 11kV H.T. XLPE/ SWA/PVC</td>
<td>M</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insulated Copper cable complete with termination and installation kits from</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>KPLC metering panel &quot;1&quot; to Client Metering Panel &quot;2&quot; as specified and shown</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>Supply, Install, Test and Commission of 1.6 MVA 11000/415V Ground-mounted</td>
<td>No.</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indoor Dry Type Transformer compete with H.T. and L.V. cable end termination</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>boxes as specified and shown on the EP _3 and EP _4.1 drawings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>Allow for earthing for the Earthing of the above items.</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>E.</td>
<td>8 x 630mm² XLPE/SWA/PVC SC CU cables + 1 x 630mm² (ECC) XLPE/PVC SC CU</td>
<td>M</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>cable from Generator Synchronizing Panel to Generator &quot;1&quot; as specified and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>shown on the EP _3 and EP _4.2 drawings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>Allow for interconnection of above items with the BMS System and Emergency/</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fire Alarm System as call for and approved by Engineer.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G.</td>
<td>Any other item necessary to complete the installation in this section (Please</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

|        | state)                                                                       |      |     |      |       |

Total carried forward to Main Summary of Prices
### SECTION D.W. 4.0 TITLE: MAIN L.V. SWITCHBOARD

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.W.4.0</td>
<td><strong>L.V. SUB-SWITCHBOARD &quot;A&quot;</strong> Supply, installation, testing &amp; commissioning of the following complete as specified. All cables shall be copper and shall be complete with cable glands, lugs and necessary termination kits. Main L.V. Switchboard labeled, Main L.V. Switchboard &quot;A&quot; complete with 2No. 3200A Air Circuit Breaker inomers, Automatic interlocking Bus coupler, 2No. 3200A AVRrs By-Pass System, 2No. 3200A Change Over System, Outgoing ACBs and MCCBs, Surge Arrestors, 2No. Power Factor correction banks, BMS and Emergency Stop System Interfaces etc.. as specified and shown on the EP_3 and EP_4.2 drawings</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Allow for the Earthing of the above items.</td>
<td>Sum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>16 x 630mm2 XLPE/SWA/PVC SC CU cables + 2 x 630mm2 (ECC) XLPE/PVC SC CU cables from Main L.V. Switchboard &quot;A&quot; to Transformer &quot;1&quot; as specified and shown on the EP _3, EP _4.1 and EP _4.2 drawings.</td>
<td>M</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>16 x 630mm2 XLPE/SWA/PVC SC CU cables + 2 x 630mm2 (ECC) XLPE/PVC SC CU cables from Main L.V. Switchboard &quot;A&quot; to Transformer &quot;2&quot; as specified and shown on the EP _3, EP _4.1 and EP _4.2 drawings.</td>
<td>M</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>16 x 630mm2 XLPE/SWA/PVC SC CU cables + 2 x 630mm2 (ECC) XLPE/PVC SC CU cables from Main L.V. Switchboard &quot;A&quot; to AVR &quot;1&quot; and back as specified and shown on the EP _3 and EP _4.2 drawings.</td>
<td>M</td>
<td>38</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total carried forward to Main Summary of Prices
**SECTION D.W. 4.0 TITLE: MAIN L.V. SWITCHBOARD**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.W.4.0</td>
<td>L.V. SUB-SWITCHBOARD &quot;A&quot;-Cont'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>24 x 630mm² XLPE/SWA/PVC SC CU cables + 3 x 630mm² (ECC) XLPE/PVC SC CU cables from Main L.V. Switchboard &quot;A&quot; to Genset sync. Panel section &quot;1&quot; as specified and shown on the EP _3 and EP _4.2 drawings.</td>
<td>M</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G.</td>
<td>24 x 630mm² XLPE/SWA/PVC SC CU cables + 3 x 630mm² (ECC) XLPE/PVC SC CU cables from Main L.V. Switchboard &quot;A&quot; to Genset sync. Panel section &quot;2&quot; as specified and shown on the EP _3 and EP _4.2 drawings.</td>
<td>M</td>
<td>59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H.</td>
<td>70mm² XLPE/SWA/PVC 4C CU cable from Main L.V. Switchboard &quot;A&quot; to Fire Fighting System as specified and shown on the drawings.</td>
<td>M</td>
<td>39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.</td>
<td>Allow for interconnection of above items with the BMS System and Emergency/Fire Alarm System as call for and approved by Engineer.</td>
<td>Sum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J.</td>
<td>Any other item necessary to complete the installation in this section (Please state)</td>
<td>Sum</td>
<td></td>
<td></td>
<td></td>
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</table>

*Total Carried Forward to Collection Page*
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
</tr>
</thead>
</table>
| D.W.5.1 | **HVAC SUB-SWITCHBOARDS & DISTRIBUTION SYSTEM - A**  
Supply, installation, testing & commissioning of the following complete as specified. All cables shall be copper and shall be complete with cable glands, lugs and necessary termination kits.  

**CHILLERS**  
A.  
4 x 400mm2 XLPE/SWA/PVC SC CU cables + 1 x 240mm2 (ECC) XLPE/PVC SC CU cable from Main L.V. Switchboard "A" to Chiller "1" as specified and shown on the EP _3 and EP _4.2 drawings.                                                                                                                                                                                                                                                                                                                                                                                                       | M    | 76  |      |       |
|        | B.  
4 x 400mm2 XLPE/SWA/PVC SC CU cables + 1 x 240mm2 (ECC) XLPE/PVC SC CU cable from Main L.V. Switchboard "A" to Chiller "2" as specified and shown on the EP _3 and EP _4.2 drawings.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | M    | 78  |      |       |
|        | C.  
Humidifier L.V. Sub-Switchboard labelled, Humidifier Set "1" complete with 1No. 500A Air Circuit Breaker incomer, Outgoing MCCBs, Surge Arrestors, BMS/Emergency Stop System Interfaces etc.. as specified and shown on the EP _3 and EP _4.6 drawings.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | No.  | 1   |      |       |
|        | D.  
Allow for the Earthing of the above items.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Sum  |     |      |       |

Total Carried Forward to Collection Page
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.W.5.1</td>
<td>HVAC SUB-SWITCHBOARDS &amp; DISTRIBUTION SYSTEM – A – Cont’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.</td>
<td>8 x 400mm² XLPE/SWA/PVC SC CU cables + 1 x 400mm² (ECC) XLPE/PVC SC CU cable from Main L.V. Switchboard &quot;A&quot; to Humidifier Set &quot;1&quot; as specified and shown on the EP _3 and EP _4.2 drawings.</td>
<td>M</td>
<td>115</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>35mm² XLPE/SWA/PVC 4C CU cable from Humidifier Set &quot;1&quot; above to Radiology &quot;H1&quot; and &quot;AHU1&quot; as specified and shown on the EP _4.6 drawing.</td>
<td>M</td>
<td>80</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| G.   | 25mm² XLPE/SWA/PVC 4C CU cable from Humidifier Set "1" above to the following as specified and shown on the EP _4.6 drawing.  
- Critical Area 1 "H2" and "AHU2"  
- Critical Area 2 "H3" and "AHU3"  
- Dialysis Area 1 "H4" and "AHU4"  
- Dialysis Area 2 "H5" and "AHU5"  
- OT Common Area 1 "H6" and "AHU6" | M    | 52  |      |       |
| H.   | 16mm² XLPE/SWA/PVC 4C CU cable from Humidifier Set "1" above to the following as specified and shown on the EP _4.6 drawing.  
- Clinics "H7" and "AHU7"  
- Extract Fan Set "EF 1"  
- Extract Fan Set "EF 2"  
- Extract Fan Set "EF 3"  
- Extract Fan Set "EF 4" | M    | 68  |      |       |
| I.   | Allow for the following isolators complete with associated accessories and labels as shown on the Contract Drawings.  
- 125A TPN  
- 100A TPN  
- 63A TPN | No. | 2   |      |       |
|      |                                                                              |     | 10  |      |       |
|      |                                                                              |     | 6   |      |       |

Total Carried Forward to Collection Page
## SECTION D.W. 5 TITLE: ELECTRICAL DISTRIBUTION SYSTEM

<table>
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<tr>
<th>Item</th>
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<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.W.5.2</td>
<td><strong>HVAC SUB-SWITCHBOARDS &amp; DISTRIBUTION SYSTEM - B</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>HUMIDIFIER SET &quot;2&quot;</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>Humidifier L.V. Sub-Switchboard labelled, Humidifier Set &quot;2&quot; complete with 1No. 250A MCCB incomer, Outgoing MCCBs, Surge Arrestors, BMS/Emergency Stop System Interfaces etc. as specified and shown on the EP _3 and EP _4.7 drawings.</td>
<td></td>
<td>No. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>Allow for the Earthing of the above items.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>4 x 240mm2 XLPE/SWA/PVC SC CU cables + 1 x 120mm2 (ECC) XLPE/PVC SC CU cable from Main L.V. Switchboard &quot;A&quot; to Humidifier Set &quot;2&quot; as specified and shown on the EP _3 and EP _4.7 drawings.</td>
<td>M</td>
<td>88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>35mm2 XLPE/SWA/PVC 4C CU cable from Humidifier Set &quot;2&quot; above to the following as specified and shown on the EP _3, EP _4.1 and EP _4.2 drawings.</td>
<td>M</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Laboratories &quot;H8&quot; and &quot;AHU8&quot;</td>
<td>M</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ OT Common Area 2 &quot;H9&quot; and &quot;AHU9&quot;</td>
<td>M</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.</td>
<td>16mm2 XLPE/SWA/PVC 4C CU cable from Humidifier Set &quot;2&quot; above to Clinics &quot;H7&quot; as specified and shown on the EP _3, EP _4.1 and EP _4.2 drawings.</td>
<td>M</td>
<td>64</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Operating Theatre 3 &quot;H12&quot; and &quot;AHU12&quot;</td>
<td>M</td>
<td>57</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Operating Theatre 4 &quot;H13&quot; and &quot;AHU13&quot;</td>
<td>M</td>
<td>57</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Morgue &quot;H14&quot; and &quot;AHU14&quot;</td>
<td>M</td>
<td>79</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Extract Fan Set &quot;EF 5&quot;</td>
<td>M</td>
<td>78</td>
<td></td>
<td></td>
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</tbody>
</table>

Total Carried Forward to Collection Page
### SECTION D.W. 5 TITLE: ELECTRICAL DISTRIBUTION SYSTEM

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<tr>
<th>Item</th>
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<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.W.5.2</td>
<td><strong>HVAC SUB-SWITCHBOARDS &amp; DISTRIBUTION SYSTEM – B - Cont’</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>Allow for the following isolators complete with associated accessories and labels as shown on the Contract Drawings.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• 100A TPN</td>
<td>No.</td>
<td>4</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• 63A TPN</td>
<td>No.</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G.</td>
<td><strong>HUMIDIFIER SET &quot;3&quot;</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>25mm2 XLPE/SWA/PVC 4C CU cable from West Wing L.V. Switchboard &quot;A2&quot; to Humidifier Set &quot;3&quot; and &quot;AHU15&quot; as specified and shown on the EP _3 and EP _4.4 drawings.</td>
<td>M</td>
<td>140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H.</td>
<td>Allow for the following isolators complete with associated accessories and labels as shown on the Contract Drawings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 63A TPN</td>
<td>No.</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.</td>
<td>Allow for interconnection of above items with the BMS System and Emergency/Fire Alarm System as call for and approved by Engineer.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J.</td>
<td>Any other item necessary to complete the installation in this section (Please state)</td>
<td></td>
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</table>

Total Carried Forward to Collection Page
## SECTION D.W. 5 TITLE: ELECTRICAL DISTRIBUTION SYSTEM

<table>
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<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
</tr>
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<tbody>
<tr>
<td>D.W.5.3</td>
<td><strong>L.V. EAST WING BUILDING SUB-SWITCHBOARDS &quot;A1&quot;</strong></td>
<td></td>
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<tr>
<td></td>
<td>Supply, installation, testing &amp; commissioning of the following complete</td>
<td></td>
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<tr>
<td></td>
<td>as specified. All cables shall be copper and shall be complete with cable</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>glands, lugs and necessary termination kits.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>Main L.V. Switchboard labelled, Main L.V. Sub-Switchboard &quot;A1, Building East</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Wing&quot; complete with 2No. 1250A Air Circuit Breakers incomer, Automatic</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>interlocking Bus coupler, 2No. UPSs Change over and by-pass System, MCCBs</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>for normal, UPS Safety and UPS Continuity, Surge Arrestors,</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>BMS/Emergency Stop System Interfaces etc.. as specified and shown on the EP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>_3 and EP _4.3 drawings.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>B.</td>
<td>Allow for the Earthing of the above items.</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>8 x 400mm2 XLPE/SWA/PVC SC CU cables + 1 x 400mm2 (ECC) XLPE/PVC SC CU</td>
<td>Sum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>cable from Main L.V. Switchboard &quot;A&quot; to East Wing Building Sub board &quot;A1&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>as specified and shown on the EP _3 and EP _4.2 drawings.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>C.</td>
<td>4 x 185mm2 XLPE/SWA/PVC SC CU cables + 1 x 95mm2 (ECC) XLPE/PVC SC CU</td>
<td>M</td>
<td>38</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>cable from East Wing Building &quot;A1&quot; subboard to Basement sub board &quot;Kitchen/</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Laundry Department&quot; as specified and shown on the drawings.</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>D.</td>
<td>70mm2 XLPE/SWA/PVC 4C CU cable + 1 x 35mm2 (ECC) XLPE/PVC SC CU cable</td>
<td>M</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>from East Wing Building subboard &quot;A1&quot; to Theatre area panel &quot;F-NE2&quot; on</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>First floor as specified and shown on the drawings.</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>E.</td>
<td>50mm2 XLPE/SWA/PVC 4C CU cable + 1 x 25mm2 (ECC) XLPE/PVC SC CU cable</td>
<td>M</td>
<td>115</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>from East Wing Building subboard &quot;A1&quot; to Dialysis Panel &quot;G-NE&quot; on Ground</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>floor as specified and shown on the drawings.</td>
<td></td>
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<tr>
<td>D.W.5.3</td>
<td><strong>L.V. EAST WING BUILDING SUB-\ SWITCHBOARDS &quot;A1&quot;: Cont</strong></td>
<td></td>
<td></td>
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</table>
| F. | 35mm² XLPE/SWA/PVC 4C CU cable from East Wing Building subboard "A1" to the following Panels as shown on the drawings.  
  - First Floor Panel "F-NE1"  
  - Second Floor Panel "S-NE1"  
  - Second Floor Panel "S-NE2"  
  - Lifts Panel "L-NE" | M | 90 | | |
| G. | 16mm² XLPE/SWA/PVC 4C CU cable from Lifts Panel "L-NE" to the following Lifts as specified and shown on the drawings.  
  - Lift 1 & 2 | M | 32 | | |
| H. | 25mm² XLPE/SWA/PVC 2C CU cable from Ground Floor Panel "G-NE" to the following Gate House CUs as specified and shown on the drawings.  
  - Gate Hose 1 "G-NE - G1"  
  - Gate Hose 2 "G-NE - G2" | M | 125 | | |
| I. | TPN Distribution Panel for Kitchen and Laundry area Complete with 400A Incomer, CBs, Surge Arrestors, BMS/Emergency Stop System Interfaces etc. as specified and shown on the EP _3 and EP _4.12 drawings. | No. | 1 | | |
| J. | 14 way TPN Distribution Board DBs for Normal Power Complete with 125A Incomer, 4x40A TPN MCBs, 8x20A SPN MCBs, 8x10A SPN MCBs, Spareways as shown on the Contract Drawings. | No. | 3 | | |
| K. | 14 way TPN Distribution Board DBs for Normal Power Complete with 100A Incomer, 3x40A SPN MCBs, 7x20A SPN MCBs, 7x10A SPN MCBs, Spareways as shown on the Contract Drawings. | No. | 3 | | |
| L. | 9 way SPN D consumer Unit CUs for Normal Power Complete with 100A Incomer, 2x20A SPN MCBs, 3x10A SPN MCBs, Spareways as shown on the Contract Drawings. | No. | 2 | | |
| M. | Allow for the 63A TPN Lifts isolators complete with associated accessories and labels as shown on the Contract Drawings. | No. | 2 | | |
| N. | Any other item necessary to complete the installation in this section (Please state) | Sum | | | |

Total Carried Forward to Collection Page
### SECTION D.W. 5 TITLE: ELECTRICAL DISTRIBUTION SYSTEM

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<tr>
<td>D.W.5.4</td>
<td><strong>L.V. WEST WING BUILDING SUB-SWITCHBOARDS &quot;A2&quot;</strong>&lt;br&gt;Supply, installation, testing &amp; commissioning of the following complete as specified. All cables shall be copper and shall be complete with cable glands, lugs and necessary termination kits.</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>Main L.V. Switchboard labelled, Main L.V. Sub-Switchboard &quot;A2, Building West Wing&quot; complete with 2No. 1250A Air Circuit Breakers incomer, Automatic interlocking Bus coupler, 2No. UPSs Change over and by-pass System, MCCBs for normal, UPS Safety and UPS Continuity, Surge Arrestors, BMS/Emergency Stop System Interfaces etc.. as specified and shown on the EP _3 and EP _4.4 drawings.</td>
<td>Sum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>Allow for the Earthing of the above items.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>8 x 400mm² XLPE/SWA/PVC SC CU cables + 1 x 400mm² (ECC) XLPE/PVC SC CU cable from Main L.V. Switchboard &quot;A&quot; to West Wing Building subboard &quot;A2&quot; as specified and shown on the EP _3 and EP _4.2 drawings.</td>
<td>M</td>
<td>56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>50mm² XLPE/SWA/PVC 4C CU cable + 1 x 25mm² (ECC) XLPE/PVC SC CU cable from West Wing Building subboard &quot;A2&quot; to the following Panels as shown on the drawings.</td>
<td>M</td>
<td>90</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ground Floor Panel &quot;G-NW&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• First Floor Panel &quot;F-NW1&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• First Floor Panel &quot;F-NW2&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.</td>
<td>35mm² XLPE/SWA/PVC 4C CU cable from West Wing Building subboard &quot;A2&quot; to the following Panels as shown on the drawings.</td>
<td>M</td>
<td>63</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Second Floor Panel &quot;S-NW1&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Second Floor Panel &quot;S-NW2&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Lifts Panel &quot;L-NE&quot;</td>
<td></td>
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### SECTION D.W. 5 TITLE: ELECTRICAL DISTRIBUTION SYSTEM

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<tr>
<td>D.W.5.4</td>
<td><strong>L.V. WEST WING BUILDING SUB-SWITCHBOARDS &quot;A2&quot; – Cont’</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>25mm² XLPE/SWA/PVC 4C CU cable from West Wing Building subboard &quot;A2&quot; to the following Panels as shown on the drawings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Parking Area Panel &quot;P-NW&quot;</td>
<td>M</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Plant Room Area Panel &quot;P-NW&quot;</td>
<td>M</td>
<td>15</td>
<td></td>
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</tr>
<tr>
<td>G.</td>
<td>16mm² XLPE/SWA/PVC 4C CU cable from Lift Panel &quot;L-NW&quot; to the following Lifts as specified and shown on the drawings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Lift 1 &amp; 2</td>
<td>M</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H.</td>
<td>16mm² XLPE/SWA/PVC 4C CU cable from West Wing Building subboard &quot;A2&quot; to the following Feeder Pillars as specified and shown on the drawings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Feeder Pillar No. 1</td>
<td>M</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Feeder Pillar No. 2</td>
<td>M</td>
<td>110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.</td>
<td>14 way TPN Distribution Board DBs for Normal Power Complete with 150A Incomer, 4x40A TPN MCBs, 8x20A SPN MCBs, 8x10A SPN MCBs, Spareways as shown on the Contract Drawings.</td>
<td>No.</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J.</td>
<td>14 way TPN Distribution Board DBs for Normal Power Complete with 125A Incomer, 4x40A SPN MCBs, 8x20A SPN MCBs, 8x10A SPN MCBs, Spareways as shown on the Contract Drawings.</td>
<td>No.</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K.</td>
<td>Allow for the 63A TPN Lifts isolators complete with associated accessories and labels as shown on the Contract Drawings.</td>
<td>No.</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.</td>
<td>Allow for interconnection of above items with the BMS System and Emergency/Fire Alarm System as call for and approved by Engineer.</td>
<td>Sum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M.</td>
<td>Any other item necessary to complete the installation in this section (Please state)</td>
<td>Sum</td>
<td></td>
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Total Carried Forward to Collection Page
## SECTION D.W. 5 TITLE: ELECTRICAL DISTRIBUTION SYSTEM

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<tr>
<td>D.W.5.5</td>
<td>L.V. SUB-SWITCHBOARD UPS CONTINUITY EAST WING &quot;UPS - C -E&quot;</td>
<td></td>
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<tr>
<td></td>
<td>Supply, installation, testing &amp; commissioning of the following complete as specified. All cables shall be copper and shall be complete with cable glands, lugs and necessary termination kits.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>4 x 120mm² XLPE/SWA/PVC SC CU cables + 1 x 70mm² (ECC) XLPE/PVC SC CU cable from East Wing Building sub-board &quot;A1&quot; to UPS &quot;UPS - C-E&quot; as specified and shown on the drawings.</td>
<td>M</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>4 x 120mm² XLPE/SWA/PVC SC CU cables + 1 x 70mm² (ECC) XLPE/PVC SC CU cable from West Wing Building sub-board &quot;A2&quot; to UPS &quot;UPS - C-E&quot; static by-pass switch as specified and shown on the drawings.</td>
<td>M</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>4 x 120mm² XLPE/SWA/PVC SC CU cables + 1 x 70mm² (ECC) XLPE/PVC SC CU cable from UPS &quot;UPS - C-E&quot; to East Wing Building sub-board via change/over system as specified and shown on the drawings.</td>
<td>M</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>50mm² XLPE/SWA/PVC 4C CU cable + 1 x 25mm² (ECC) XLPE/PVC SC CU cable from East Wing Building subboard &quot;A1&quot; UPS Continuity section to the following Panels as shown on the drawings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• First Floor Panel &quot;F-UPS - C-E1&quot;</td>
<td>M</td>
<td>90</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• First Floor Panel &quot;F-UPS - C-E2&quot;</td>
<td>M</td>
<td>116</td>
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<td>D.W.5.5</td>
<td><strong>L.V. SUB-SWITCHBOARD UPS CONTINUITY EAST WING &quot;UPS - C -E&quot; – Cont’</strong></td>
<td></td>
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<tr>
<td>E.</td>
<td>35mm² XLPE/SWA/PVC 4C CU cable from East Wing Building subboard “A1” UPS Continuity section to the following Panels as shown on the drawings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Basement Panel &quot;B-UPS - C -E&quot;</td>
<td>M</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Ground Floor Panel &quot;G-UPS - C -E&quot;</td>
<td>M</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Second Floor Panel &quot;S-UPS - C -E1&quot;</td>
<td>M</td>
<td>95</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Second Floor Panel &quot;S-UPS - C -E2&quot;</td>
<td>M</td>
<td>111</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>12 way TPN Distribution Board DBs named As above for UPS Power Complete with 16x20A SPN MCBs, Spareways and Blanking Plates as shown on the Contract Drawings.</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>No.</td>
<td></td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G.</td>
<td>Allow for interconnection of above items with the BMS System and Emergency/Fire Alarm System as call for and approved by Engineer.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H.</td>
<td>Any other item necessary to complete the installation in this section (Please state)</td>
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### SECTION D.W. 5 TITLE: ELECTRICAL DISTRIBUTION SYSTEM

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<tr>
<td><strong>D.W.5.6</strong></td>
<td><strong>L.V. SUB-SWITCHBOARD UPS CONTINUITY WEST WING &quot;UPS - C -W&quot;</strong></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Supply, installation, testing &amp; commissioning of the following complete as specified. All cables shall be copper and shall be complete with cable glands, lugs and necessary termination kits.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>4 x 120mm² XLPE/SWA/PVC SC CU cables + 1 x 70mm² (ECC) XLPE/PVC SC CU cable from West Wing Building sub-board &quot;A2&quot; to UPS &quot;UPS - C -W&quot; as specified and shown on the drawings.</td>
<td>M</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>4 x 120mm² XLPE/SWA/PVC SC CU cables + 1 x 70mm² (ECC) XLPE/PVC SC CU cable from East Wing Building sub-board &quot;A1&quot; to UPS &quot;UPS - C -W&quot; static by-pass switch as specified and shown on the drawings.</td>
<td>M</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>4 x 120mm² XLPE/SWA/PVC SC CU cables + 1 x 70mm² (ECC) XLPE/PVC SC CU cable from UPS &quot;UPS - C -W&quot; to West Wing Building sub-board via change/over system as specified and shown on the drawings.</td>
<td>M</td>
<td>26</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| D.     | 50mm² XLPE/SWA/PVC 4C CU cable + 1 x 25mm² (ECC) XLPE/PVC SC CU cable from West Wing Building subboard "A2" UPS Continuity section to the following Panels as shown on the drawings.  
  - First Floor Panel "F-UPS - C -W1"  
  - First Floor Panel "F-UPS - C -W2" | M    | 78  |      |       |

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| D.W.5.6 | **L.V. SUB-SWITCHBOARD UPS**  
CONTINUITY WEST WING "UPS - C -W" – Cont’ |      |     |      |       |
| E.     | 25mm² XLPE/SWA/PVC 4C CU cable from East Wing Building subboard "A2" UPS Continuity section to the following Panels as shown on the drawings.  
▪ Plant Room Panel "P-UPS - C -W"  
▪ Ground Floor Panel "G-UPS - C -W"  
▪ Second Floor Panel "S-UPS - C -W1"  
▪ Second Floor Panel "S-UPS - C -W2" | M    | 17  |      |       |
| F.     | 12 way TPN Distribution Board DBs named As above for UPS Power Complete with 16x20A SPN MCBs, Spareways and Blanking Plates as shown on the Contract Drawings. | No.  | 6   |      |       |
| G.     | Allow for interconnection of above items with the BMS System and Emergency/Fire Alarm System as call for and approved by Engineer. | Sum  |     |      |       |
| H.     | Any other item necessary to complete the installation in this section (Please state) | Sum  |     |      |       |

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<td>D.W.5.7</td>
<td><strong>L.V. SUB-SWITCHBOARD UPS SAFETY EAST WING &quot;UPS - S -E&quot;</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply, installation, testing &amp; commissioning of the following complete as specified. All cables shall be copper and shall be complete with cable glands, lugs and necessary termination kits.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>95mm² XLPE/SWA/PVC 4C CU cable + 1 x 50mm² (ECC) XLPE/PVC SC CU cable from East Wing Building sub-board &quot;A1&quot; to UPS &quot;UPS - S -E&quot; as specified and shown on the drawings.</td>
<td>M</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>95mm² XLPE/SWA/PVC 4C CU cable + 1 x 50mm² (ECC) XLPE/PVC SC CU cable from West Wing Building sub-board &quot;A2&quot; to UPS &quot;UPS - S -E&quot; static by-pass switch as specified and shown on the drawings.</td>
<td>M</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>95mm² XLPE/SWA/PVC 4C CU cable + 1 x 50mm² (ECC) XLPE/PVC SC CU cable from UPS &quot;UPS - S -E&quot; to East Wing Building sub-board via change/over system as specified and shown on the drawings.</td>
<td>M</td>
<td>27</td>
<td></td>
<td></td>
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</table>
| D.       | 50mm² XLPE/SWA/PVC 4C CU cable + 1 x 25mm² (ECC) XLPE/PVC SC CU cable from East Wing Building subboard "A1" UPS Safety section to the following Panels as shown on the drawings.  
  - First Floor Panel "F-UPS - S -E1"  
  - First Floor Panel "F-UPS - S -E2" | M    | 90  |      |       |
|          | Total Carried Forward to Collection Page                                   |      |     |      |       |
### SECTION D.W. 5 TITLE: ELECTRICAL DISTRIBUTION SYSTEM

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
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<th>KShs.</th>
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<tr>
<td>D.W.5.7</td>
<td><strong>L.V. SUB-SWITCHBOARD UPS SAFETY EAST WING &quot;UPS - S -E&quot; – Cont’</strong></td>
<td></td>
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<tr>
<td>E.</td>
<td>25mm² XLPE/SWA/PVC 4C CU cable from East Wing Building subboard “A1&quot; UPS Safety section to the following Panels as shown on the drawings.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Ground Floor Panel &quot;G-UPS - S -E&quot;</td>
<td>M</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Second Floor Panel &quot;S-UPS - S -E1&quot;</td>
<td>M</td>
<td>95</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Second Floor Panel &quot;S-UPS - S -E2&quot;</td>
<td>M</td>
<td>111</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>12 way TPN Distribution Board DBs named As above for UPS Power Complete with 14x20A SPN MCBs, Spareways and Blanking Plates as shown on the Contract Drawings.</td>
<td>No.</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G.</td>
<td>Allow for interconnection of above items with the BMS System and Emergency/Fire Alarm System as call for and approved by Engineer.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H.</td>
<td>Any other item necessary to complete the installation in this section (Please state)</td>
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Total Carried Forward to Collection Page
### SECTION D.W. 5 TITLE: ELECTRICAL DISTRIBUTION SYSTEM

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<tr>
<th>Item</th>
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<tbody>
<tr>
<td>D.W.5.8</td>
<td><strong>L.V. SUB-SWITCHBOARD UPS SAFETY WEST WING &quot;UPS - S -W&quot;</strong></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Supply, installation, testing &amp; commissioning of the following complete as specified. All cables shall be copper and shall be complete with cable glands, lugs and necessary termination kits.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>95mm² XLPE/SWA/PVC 4C CU cable + 1 x 50mm² (ECC) XLPE/PVC SC CU cable from West Wing Building sub-board &quot;A2&quot; to UPS &quot;UPS - S -W&quot; as specified and shown on the drawings.</td>
<td>M</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>95mm² XLPE/SWA/PVC 4C CU cable + 1 x 50mm² (ECC) XLPE/PVC SC CU cable from East Wing Building sub-board &quot;A1&quot; to UPS &quot;UPS - S -W&quot; static by-pass switch as specified and shown on the drawings.</td>
<td>M</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>95mm² XLPE/SWA/PVC 4C CU cable + 1 x 50mm² (ECC) XLPE/PVC SC CU cable from UPS &quot;UPS - S -W&quot; to West Wing Building sub-board via change/over system as specified and shown on the drawings.</td>
<td>M</td>
<td>27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| D. | 50mm² XLPE/SWA/PVC 4C CU cable + 1 x 25mm² (ECC) XLPE/PVC SC CU cable from West Wing Building subboard "A2" UPS Safety section to the following Panels as shown on the drawings.  
  - First Floor Panel "F-UPS - S -W1"  
  - First Floor Panel "F-UPS - S -W2" | M | 40 | 101 |

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<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
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<tr>
<td>D.W.5.8</td>
<td>L.V. SUB-SWITCHBOARD UPS SAFETY WEST WING &quot;UPS - S-W&quot;-Cont’</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>E.</td>
<td>25mm² XLPE/SWA/PVC 4C CU cable from East Wing Building subboard “A2” UPS Safety section to the following Panels as shown on the drawings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ground Floor Panel &quot;G-UPS - S -W&quot;</td>
<td>M</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Second Floor Panel &quot;S-UPS - S -W1&quot;</td>
<td>M</td>
<td>63</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Second Floor Panel &quot;S-UPS - S -W2&quot;</td>
<td>M</td>
<td>54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>12 way TPN Distribution Board DBs named As above for UPS Power Complete with 16x20A SPN MCBs, Spareways and Blanking Plates as shown on the Contract Drawings.</td>
<td>No.</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G.</td>
<td>Allow for interconnection of above items with the BMS System and Emergency/Fire Alarm System as call for and approved by Engineer.</td>
<td></td>
<td></td>
<td>Sum</td>
<td></td>
</tr>
<tr>
<td>H.</td>
<td>Any other item necessary to complete the installation in this section (Please state)</td>
<td></td>
<td></td>
<td>Sum</td>
<td></td>
</tr>
</tbody>
</table>
### SECTION D.W. 5 TITLE: ELECTRICAL DISTRIBUTION SYSTEM

<table>
<thead>
<tr>
<th>Item</th>
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<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D.W.5.9</strong></td>
<td><strong>L.V. SUB-SWITCHBOARD UNIVERSITY &quot;U&quot;</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply, installation, testing &amp; commissioning of the following complete as specified. All cables shall be copper and shall be complete with cable glands, lugs and necessary termination kits.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>Main L.V. Switchboard for University East Wing labelled, Main L.V. Switchboard &quot;U&quot; complete with 1No. 400A ACB incomer, MCCBs, UPS Bypass Switch, UPS MCCBs, Check Meter, Surge Arrestors, MCCBs, BMS Interfaces etc., as specified and shown on the EP _3 and EP _4.5 drawings.</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>Allow for the Earthing of the above items.</td>
<td>Sum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>4 x 400mm² XLPE/SWA/PVC SC CU cables + 1 x 240mm² (ECC) XLPE/PVC SC CU cable from Main L.V. switch board &quot;A&quot; to University sub board &quot;U&quot; as specified and shown on the drawings.</td>
<td>M</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>50mm² XLPE/SWA/PVC 4C CU cable + 1 x 25mm² (ECC) XLPE/PVC SC CU cable from University sub board &quot;U&quot; to UPS &quot;UPS - U&quot; and back to UPS By-pass switch as specified and shown on the EP _3 and EP _4.5 drawings.</td>
<td>M</td>
<td>36</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| E. | 25mm² XLPE/SWA/PVC 4C CU cable from University subboard "U" to the following area as specified and shown on the drawings:  
  ▪ Ground Floor DB  
  ▪ First Floor DB  
  ▪ Second Floor DB  
  ▪ Lift | M | 10 |  |  |
  |  | M | 16 |  |  |
  |  | M | 21 |  |  |
  |  | M | 30 |  |  |

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<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
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<th>Qty</th>
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<tr>
<td>D.W.5.9</td>
<td><strong>L.V. SUB-SWITCHBOARD UNIVERSITY &quot;U&quot; – Cont’</strong></td>
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<tr>
<td>F.</td>
<td>16mm² XLPE/SWA/PVC 4C CU cable from University subboard &quot;U&quot; to the following UPS DBs as specified and shown on the drawings;</td>
<td>M</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ground Floor DB</td>
<td>M</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• First Floor DB</td>
<td>M</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G.</td>
<td>14 way TPN Distribution Board DBs named As above for Normal Power Complete with 5x32A SPN MCBs 5x20A SPN MCBs, 5x10A SPN MCBs Spareways and Blanking Plates as shown on the Contract Drawings.</td>
<td>No.</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H.</td>
<td>10 way TPN Distribution Board DBs named As above for UPS Power Complete with 8x20A SPN MCBs, 2x10A SPN MCBs Spareways and Blanking Plates as shown on the Contract Drawings.</td>
<td>No.</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.</td>
<td>Allow for interconnection of above items with the BMS System and Emergency/Fire Alarm System as call for and approved by Engineer.</td>
<td>Sum</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>J.</td>
<td>Any other item necessary to complete the installation in this section (Please state)</td>
<td>Sum</td>
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Total Carried Forward to Collection Page
### SECTION D.W. 5 TITLE: ELECTRICAL DISTRIBUTION SYSTEM

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<th>Rate</th>
<th>KShs.</th>
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</table>
| D.W.5.10     | **ELECTRICAL DISTRIBUTION SYSTEM - RADIOLOGY, KITCHEN AND LAUNDRY DEPARTMENTS**
Supply, installation, testing & commissioning of the following complete as specified. All cables shall be copper and shall be complete with cable glands, lugs and necessary termination kits. |      |     |      |       |
|               | **A. RADIOLOGY**
Cables to be supplied together with machines (allow only conduit work, riseways and associated accessories) |      |     |      |       |
|               | **CSSD AND KITCHEN DEPARTMENT** |      |     |      |       |
|               | **B.** 25mm² XLPE/SWA/PVC 4C CU cable from Kitchen/Laundry Department to the following units as specified and shown on the drawings; |      |     |      |       |
|               | - Laundry Machine 1 (Pullman barrier washer extractor) M 40 |      |     |      |       |
|               | - Laundry Machine 2 (Pullman barrier washer extractor) M 50 |      |     |      |       |
|               | - Laundry Machine 3 (Pullman barrier washer extractor) M 45 |      |     |      |       |
|               | - Laundry Machine 4 (Pullman barrier washer extractor) M 44 |      |     |      |       |
|               | **C.** 16mm² XLPE/SWA/PVC 4C CU cable from Kitchen/Laundry Department to the following units as specified and shown on the drawings; |      |     |      |       |
|               | - Laundry Machine 5 (Tumble dryer) M 55 |      |     |      |       |
|               | - Laundry Machine 6 (Tumble dryer) M 50 |      |     |      |       |
|               | - Kitchen Machine 1 (conveyor dishwasher as Hobart) M 47 |      |     |      |       |

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<table>
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<tr>
<th>Item</th>
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<tbody>
<tr>
<td>D.W.5.10</td>
<td><strong>ELECTRICAL DISTRIBUTION SYSTEM - RADIOLOGY, KITCHEN AND LAUNDRY DEPARTMENTS – Cont</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| D.     | 10mm² XLPE/SWA/PVC 4C CU cable from Kitchen/Laundry Department to the following units as specified and shown on the drawings;  
  - Kitchen Machine 2 (electric cooking range GN2/1)          | M    | 49  |     |       |
|        | - Kitchen Machine 3 (Electric Double-Deck Full Size Convection Oven)                                   | M    | 54  |     |       |
|        | - Kitchen Machine 4 (Ground Floor electric cooking range)                                              | M    | 105 |     |       |
| E.     | 6mm² PVC/SWA/PVC 4C CU cable from Kitchen/Laundry Department to the following units as specified and shown on the drawings;  
  - Laundry Machine 7 (Rectangular wet work press)            | M    | 45  |     |       |
|        | - Laundry Machine 8 (Rectangular wet work press)                                                       | M    | 41  |     |       |
| F.     | Allow for the following isolators complete with associated accessories and labels as shown on the Contract Drawings.  
  - 125A TPN                                                  | No.  | 4   |     |       |
|        | - 100A TPN                                               | No.  | 3   |     |       |
|        | - 63A TPN                                                | No.  | 5   |     |       |
|        | - 32A TPN                                                | No.  | 4   |     |       |
| G.     | Any other item necessary to complete the installation in this section (Please state)                  | Sum  |     |     |       |

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<tr>
<td>D.W.5.11</td>
<td><strong>ELECTRICAL DISTRIBUTION SYSTEM - CRITICAL AREA</strong>&lt;br&gt;Supply, installation, testing &amp; commissioning of the following complete as specified. All cables shall be copper and shall be complete with cable glands, lugs and necessary termination kits.</td>
<td>No.</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>TYPICAL THEATRE ROOM WIRING</strong>&lt;br&gt;A. Supply, install, Test and Commission of 5kVA Single Phase Isolation Transformer for IT Medical wiring system complete with 63A SPN Automatic Static Transfer Switch (Make before Break), earth reference bars, Local Isolation Monitor, CTs, Relays, RCBOs, Spareways housed in IP54 cabinet and complete with local and remote alarm panels as specified and shown on the EP _4.10 drawing.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. 10mm² XLPE/SWA/PVC 3C CU cable from First Floor &quot;F-UPS - S -E1&quot; to the following units as specified and shown on the drawings;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• First Floor &quot;F-UPS - S -E1&quot; to above Operation Theatre 1 (IT Medical)</td>
<td>M</td>
<td>82</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• First Floor &quot;F-UPS - S -E1&quot; to above Operation Theatre 2 (IT Medical)</td>
<td>M</td>
<td>74</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• First Floor &quot;F-UPS - S -E1&quot; to above Operation Theatre 3 (IT Medical)</td>
<td>M</td>
<td>67</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• First Floor &quot;F-UPS - S -E1&quot; to above Operation Theatre 4 (IT Medical)</td>
<td>M</td>
<td>54</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. 2 x 10mm² XLPE/SWA/PVC 3C CU cable from First Floor &quot;F-UPS - S -E2&quot; to the following units as specified and shown on the drawings;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• First Floor &quot;F-UPS - S -E2&quot; to above Operation Theatre 1 (IT Medical)</td>
<td>M</td>
<td>82</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• First Floor &quot;F-UPS - S -E2&quot; to above Operation Theatre 2 (IT Medical)</td>
<td>M</td>
<td>74</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• First Floor &quot;F-UPS - S -E2&quot; to above Operation Theatre 3 (IT Medical)</td>
<td>M</td>
<td>67</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• First Floor &quot;F-UPS - S -E2&quot; to above Operation Theatre 4 (IT Medical)</td>
<td>M</td>
<td>54</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. Allow for the Earthing System of the above items.</td>
<td>Sum</td>
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<td><strong>Total Carried Forward to Collection Page</strong></td>
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<tr>
<td>D.W.5.11</td>
<td>**ELECTRICAL DISTRIBUTION SYSTEM - CRITICAL AREA – Cont'}</td>
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<tr>
<td></td>
<td>E. Allow for interconnection of above items with the BMS System and Emergency/Fire Alarm System as call for and approved by Engineer.</td>
<td></td>
<td></td>
<td></td>
<td>Sum</td>
</tr>
<tr>
<td></td>
<td><strong>ICU AREA WIRING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F. Supply, install, Test and Commission of 5kVA Single Phase Isolation Transformer for IT Medical wiring system complete with 63A SPN Automatic Static Transfer Switch (Make before Break), earth reference bars, Local Isolation Monitor, CTs, Relays, RCBOs, Spareways housed in IP54 cabinet and complete with local and remote alarm panels as specified and shown on the EP _4.11 drawing.</td>
<td>No.</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>G. 10mm2 XLPE/SWA/PVC 5C CU cable from First Floor &quot;F-UPS - S -W1&quot; to the following units as specified and shown on the drawings;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- First Floor &quot;F-UPS - S -W1&quot; to above Critical Bed Set 1 (IT Medical)</td>
<td>M</td>
<td>49</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- First Floor &quot;F-UPS - S -W1&quot; to above Critical Bed Set 2 (IT Medical)</td>
<td>M</td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- First Floor &quot;F-UPS - S -W1&quot; to above Critical Bed Set 3 (IT Medical)</td>
<td>M</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>H. 10mm2 XLPE/SWA/PVC 5C CU cable from First Floor &quot;F-UPS - S -W2&quot; to the following units as specified and shown on the drawings;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- First Floor &quot;F-UPS - S -W2&quot; to above Critical Bed Set 1 (IT Medical)</td>
<td>M</td>
<td>49</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- First Floor &quot;F-UPS - S -W2&quot; to above Critical Bed Set 2 (IT Medical)</td>
<td>M</td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- First Floor &quot;F-UPS - S -W2&quot; to above Critical Bed Set 3 (IT Medical)</td>
<td>M</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>H. Allow for the Earthing System of the above items.</td>
<td>Sum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I. Allow for interconnection of above items with the BMS System and Emergency/Fire Alarm System as call for and approved by Engineer.</td>
<td></td>
<td></td>
<td></td>
<td>Sum</td>
</tr>
<tr>
<td></td>
<td>J. Any other item necessary to complete the installation in this section (Please state)</td>
<td></td>
<td></td>
<td></td>
<td>Sum</td>
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</table>

**Total Carried Forward to Collection Page**
### SECTION D.W. 5 TITLE: ELECTRICAL DISTRIBUTION SYSTEM

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D.W.5.12</strong></td>
<td><strong>ELECTRICAL DISTRIBUTION SYSTEM - OTHER MECHANICAL SERVICES</strong> Supply, installation, testing &amp; commissioning of the following complete as specified. All cables shall be copper and shall be complete with cable glands, lugs and necessary termination kits. <strong>MEDICAL GAS DISTRIBUTION</strong> Cables to be supplied together with machines (allow only conduit work, riseways and associated accessories. <strong>WATER TREATMENT DISTRIBUTION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>Main L.V. Sub-Switchboard for Water Treatment labelled, Main L.V. Sub-Switchboard &quot;W&quot; complete with 1No. 150A MCCB incomer, Outgoing MCCBs, Check Meter, Surge Arrestors, BMS Interfaces etc. the EP _3 and EP _4.9 drawings.</td>
<td>No. 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>25mm² XLPE/SWA/PVC 4C CU cable from Water Treatment Sub-Switchboard &quot;W&quot; above to Borehole &quot;W1&quot; as EP _4.9 drawing</td>
<td>M 67</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| C.            | 16mm² XLPE/SWA/PVC 4C CU cable from Water Treatment Sub-Switchboard "W" above to the following Plants as on EP _4.9 drawing  
- Water Treatment Plant "W2"  
- Water Booster Plant "W3" | M 31 |     |      |       |
| D.            | 6mm² XLPE/SWA/PVC 4C CU cable from Water Treatment Sub-Switchboard "W" above to the following Plants as EP _4.9 drawing  
- RO Plant "W4"  
- RO Plant "W4" | M 66 |     |      |       |
| E.            | Allow for the Earthing System of the above items. | Sum |     |      |       |
| F.            | Allow for interconnection of above items with the BMS System and Emergency/Fire Alarm System as call for and approved by Engineer. | Sum |     |      |       |
| K.            | Any other item necessary to complete the installation in this section (Please state) | Sum |     |      |       |

Total Carried Forward to Collection Page
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
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<th>Rate</th>
<th>KShs.</th>
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<td>D.W.5.13</td>
<td><strong>ELECTRICAL DISTRIBUTION SYSTEM</strong></td>
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<td></td>
<td><em>Collection page</em></td>
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</tr>
<tr>
<td>A</td>
<td>HVAC SUB-SWITCHBOARDS &amp; DISTRIBUTION SYSTEM - A</td>
<td></td>
<td></td>
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<tr>
<td>B</td>
<td>HVAC SUB-SWITCHBOARDS &amp; DISTRIBUTION SYSTEM - B</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>C</td>
<td>L.V. EAST WING BUILDING SUB-SWITCHBOARDS &quot;A1&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>L.V. WEST WING BUILDING SUB-SWITCHBOARDS &quot;A2&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>L.V. SUB-SWITCHBOARD UPS CONTINUITY EAST WING &quot;UPS - C - E&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>L.V. SUB-SWITCHBOARD UPS CONTINUITY WEST WING &quot;UPS - C - W&quot;</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>G</td>
<td>L.V. SUB-SWITCHBOARD UPS SAFETY EAST WING &quot;UPS - S -E&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>L.V. SUB-SWITCHBOARD UPS SAFETY WEST WING &quot;UPS - S -W&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>L.V. SUB-SWITCHBOARD UNIVERSITY &quot;U&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>ELECTRICAL DISTRIBUTION SYSTEM - RADIOLOGY, KITCHEN AND LAUNDRY DEPARTMENTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>ELECTRICAL DISTRIBUTION SYSTEM - CRITICAL AREA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>ELECTRICAL DISTRIBUTION SYSTEM - OTHER MECHANICAL SERVICES</td>
<td></td>
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</tr>
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</table>

Total Carried to Main Summary of Prices.
### SECTION D.W. 6.0 TITLE: LIGHTING AND POWER INSTALLATION

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
</tr>
</thead>
</table>
| D.W.6.1a | **LIGHTING AND SMALL POWER INSTALLATION**  
**Basement** |  |  |  |  |
| | Supply and install the following complete as specified or approved equivalent: |  |  |  |  |
| A. | Lighting points wired in 1.5mm² pvc/sc copper cables drawn in 20mm diameter pvc heavy gauge conduits complete with switching accessories as shown on drawings. | No. | 349 |  |  |
| B. | The following luminaires complete with rated lamps as specified: | No. |  |  |  |
| | • TYPE (J4) - IP65 38W, 240V 600 x 600mm LED Light Panel Luminaire | 23 |  |  |  |
| | • Type (J4E) as J4 but with Emergency kit | 8 |  |  |  |
| | • TYPE (C) - IP65 38W, 240V 1200 x 300mm LED Light Panel Luminaire | 31 |  |  |  |
| | • Type (CE) as C but with Emergency kit | 17 |  |  |  |
| | • TYPE (R2) -1500mm, 60W LED, IP65 Polycarbonate Triple Ant-corrosive luminaire | 89 |  |  |  |
| | • Type (R2E) as R2 but with Emergency kit | 28 |  |  |  |
| | • TYPE (B2)1200mm, 45W, IP20 Slim-line LED luminaire | 9 |  |  |  |
| | • Type (B2E) as B2 but with Emergency kit | 5 |  |  |  |
| | • TYPE (L) - 16W IP65 rated, Surface mounted polycarbonate bulkhead luminaire | 3 |  |  |  |
| | • Type (LE) as L but with Emergency kit | 3 |  |  |  |
| | • TYPE (N) -12W LED, IP54 Low Profile Surface Mounted luminaire fitted with microwave sensor | 17 |  |  |  |
| | • TYPE (ML) -10W LED, 1X600mm, IP54 Low Profile Surface Mounted luminaire fitted with microwave sensor | 14 |  |  |  |
| | • TYPE (RL) - 6W, IP66 LED Rectangular Recessed External Wall Light luminaire | 12 |  |  |  |
| | • TYPE (X) -12W, Surface Mounted Bulkhead with die cast black AL Body luminaire | 7 |  |  |  |

Total Carried Forward to Collection Page
**SECTION D.W. 6.0 TITLE: LIGHTING AND POWER INSTALLATION**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
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<tbody>
<tr>
<td>D.W.6.1a</td>
<td>LIGHTING AND SMALL POWER INSTALLATION Basement – Cont’</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• TYPE (G) -30W, IP65 Slim Profile LED External Wall bracket luminaire</td>
<td>No.</td>
<td>57</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Type Wall mounted One sided LED Emergency Exit Sign</td>
<td>No.</td>
<td>20</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Type ceiling mounted two sided LED Emergency Exit Sign</td>
<td>No.</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Light Motion sensor (occupancy sensor)</td>
<td>No.</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>10A moulded ivory switch plate as cabtree or approved as follows;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• One Gang One way Architrave switches</td>
<td>No.</td>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• One Gang One way (Dimmer) Architrave switches</td>
<td>No.</td>
<td>5</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• One Gang Two way Architrave switches</td>
<td>No.</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Two Gang One way Architrave switches</td>
<td>No.</td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td>• Two Gang Two way Architrave switches</td>
<td>No.</td>
<td>4</td>
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<tr>
<td></td>
<td>• Three Gang One way Architrave switches</td>
<td>No.</td>
<td>8</td>
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Total Carried Forward to Collection Page

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<th>Rate</th>
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<tr>
<td>D.W.6.1b</td>
<td>LIGHTING AND SMALL POWER INSTALLATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Basement - Cont'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The following power outlets complete with 25mm diameter PVC Heavy gauge conduits, all accessories and wiring as specified:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 13A Twin Water Tight Metal Glade Socket outlet</td>
<td>No.</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 13A Twin Standard Socket outlet in &quot;White&quot; Colour for Normal power</td>
<td>No.</td>
<td>43</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 13A Twin Standard Socket outlet in &quot;RED&quot; Colour for clean power.</td>
<td>No.</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 15A Round Pin Socket outlet</td>
<td>No.</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 45A Cooker Unit complete with connector</td>
<td>No.</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 32A SPN Industrial Socket complete with 2x4.0 Sq mm pvc/swa/pvc CU Cable (approx. 55metres) and associated accessories for Kitchen area</td>
<td>No.</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 32A SPN Isolator complete with 2x4.0 Sq mm pvc/swa/pvc CU Cable (approx. 45metres) and associated accessories for Kitchen area</td>
<td>No.</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 20A D.P. Switch for kitchen</td>
<td>No.</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 15A SPN Spur Switched Socket outlet</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Allow for power supply to Door Holders &amp; Fire Dampers complete with LSZH fire resistant cabling and conduit work</td>
<td>No.</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>The following specialized outlet points complete with 25mm diameter PVC Heavy gauge conduit and all accessories as specified:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Twin Data Outlet complete with Conduit only &amp; Draw wire.</td>
<td>No.</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Security point Outlet complete with Conduit only &amp; draw wire.</td>
<td>No.</td>
<td>38</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Clock point Outlet complete with Conduit only &amp; draw wire.</td>
<td>No.</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Speaker point Outlet complete with Conduit only &amp; draw wire.</td>
<td>No.</td>
<td>47</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>▪ BMS point Outlet complete with Conduit only &amp; draw wire.</td>
<td>No.</td>
<td>24</td>
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</tr>
<tr>
<td>F</td>
<td>Any other item to complete the installation in this section (Please state).</td>
<td></td>
<td></td>
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Total Carried Forward to Collection Page
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<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
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<tr>
<td>D.W.6.2a</td>
<td><strong>LIGHTING AND SMALL POWER INSTALLATION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Ground Floor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply and install the following complete as specified or approved equivalent:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>Lighting points wired in 1.5mm² pvc/sc copper cables drawn in 20mm diameter pvc heavy gauge conduits complete with switching accessories as shown on drawings.</td>
<td>No.</td>
<td>844</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>The following luminaires complete with rated lamps as specified:</td>
<td>No.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ TYPE (J4) - IP65 38W, 240V 600 x 600mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>71</td>
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</tr>
<tr>
<td></td>
<td>▪ Type (J4E) as J4 but with Emergency kit</td>
<td>No.</td>
<td>40</td>
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</tr>
<tr>
<td></td>
<td>▪ TYPE (C) - IP65 38W, 240V 1200 x 300mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>62</td>
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</tr>
<tr>
<td></td>
<td>▪ Type (CE) as C but with Emergency kit</td>
<td>No.</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ TYPE (WL) - IP65 38W, 240V 1200 x 300mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>26</td>
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<tr>
<td></td>
<td>▪ Type (WLE) as WL but with Emergency kit</td>
<td>No.</td>
<td>7</td>
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</tr>
<tr>
<td></td>
<td>▪ TYPE (R2) - 1500mm, 60W LED, IP65 Polycarbonate Triple Ant-corrosive luminaire</td>
<td>No.</td>
<td>5</td>
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</tr>
<tr>
<td></td>
<td>▪ Type (R2E) as R2 but with Emergency kit</td>
<td>No.</td>
<td>2</td>
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</tr>
<tr>
<td></td>
<td>▪ TYPE (B2) 1200mm, 45W, IP20 Slim-line LED luminaire</td>
<td>No.</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Type (B2E) as B2 but with Emergency kit</td>
<td>No.</td>
<td>15</td>
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</tr>
<tr>
<td></td>
<td>▪ TYPE (H12) - IP65 60W, 240V 1200 x 600mm LED Light Panel</td>
<td>No.</td>
<td>4</td>
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</tr>
<tr>
<td></td>
<td>▪ Type (H12E) as H12 but with Emergency kit</td>
<td>No.</td>
<td>4</td>
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<tr>
<td></td>
<td>▪ TYPE (L) - 16W IP65 rated, Surface mounted polycarbonate bulkhead</td>
<td>No.</td>
<td>7</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>▪ Type (LE) as L but with Emergency kit</td>
<td>No.</td>
<td>6</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>▪ TYPE (N) - 12W LED, IP54 Low Profile Surface Mounted luminaire fitted with microwave sensor</td>
<td>No.</td>
<td>85</td>
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</tr>
<tr>
<td></td>
<td>▪ TYPE (ML) - 10W LED, 1X600mm, IP54 Low Profile Surface Mounted luminaire fitted with microwave sensor</td>
<td>No.</td>
<td>55</td>
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<tr>
<td></td>
<td>▪ TYPE (D) - 16W Recessed Dimmable Down lighter complete with drivers</td>
<td>No.</td>
<td>13</td>
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</table>

Total Carried Forward to Collection Page
### SECTION D.W. 6.0 TITLE: LIGHTING AND POWER INSTALLATION

**Item** | **Description** | **Unit** | **Qty** | **Rate** | **KShs.**  
--- | --- | --- | --- | --- | ---  
D.W.6.2a | LIGHTING AND SMALL POWER INSTALLATION  
Ground Floor – Cont’  
- Type (DE) as D but with Emergency kit  
- TYPE (D2) - 15W LED Square Recessed Down lighter luminaire  
- Type (D2E) as D2 but with Emergency kit  
- TYPE (NL) - 1.5W LED, 240V IP54 Stainless Steel Rectangular Recessed Wall Luminaire  
- TYPE (RL) - 6W, IP66 LED Rectangular Recessed External Wall Light  
- TYPE (X) - 12W, Surface Mounted Buildhead with die cast black AL Body  
- TYPE (G) - 30W, IP65 Slim Profile LED External Wall, wall bracket  
- TYPE (GL) - 11W, IP66 high-output, exterior spotlight for garden lighting Luminaire  
- Type Wall mounted One sided LED Emergency Exit Sign  
- Type ceiling mounted two sided LED Emergency Exit Sign  
- Examination Light @ 1200mm AFFFL  
- Allow for 15 metres of 24V DC IP68 RGB Flexible High Density LED Strip Light complete with transformer, control drivers and associated accessories  
- Allow for Operation Warning Light wired to machine (coordinate with supplier)  
- Light Motion sensor (occupancy sensor)  
- Bed Head Luminaire  
- 10A moulded ivory switch plate as cabtree or approved as follows;  
- One Gang One way Architrave switches  
- One Gang One way (Dimmer) Architrave switches  
- One Gang Two way Architrave switches  
- Two Gang One way Architrave switches  
- Two Gang Two way Architrave switches  
- Three Gang One way Architrave switches  

| No. | 3 | 92 | 21 | 46 | 42 | 7 | 64 | 23 | 40 | 32 | 7 | 15 | 13 | 83 | 33 | 123 | 17 | 4 | 3 | 4 | 13 |  

**Total Carried Forward to Collection Page**
## SECTION D.W. 6.0 TITLE: LIGHTING AND POWER INSTALLATION

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
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<tbody>
<tr>
<td>D.W.6.2b</td>
<td>LIGHTING AND SMALL POWER INSTALLATION</td>
<td></td>
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<tr>
<td></td>
<td><strong>Ground Floor - Cont'</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>The following power outlets complete with 25mm diameter PVC Heavy gauge conduits, all accessories and wiring as specified:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 13A Twin Standard Socket outlet in &quot;Blue&quot; Colour for Critical Power</td>
<td></td>
<td>25</td>
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<td></td>
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<tr>
<td></td>
<td>▪ 13A Twin Standard Socket outlet in &quot;White&quot; Colour for Normal power</td>
<td></td>
<td>195</td>
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<tr>
<td></td>
<td>▪ 13A Twin Standard Socket outlet in &quot;RED&quot; Colour for clean power.</td>
<td></td>
<td>134</td>
<td></td>
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<tr>
<td></td>
<td>▪ 3X2.5sq mm pvc sc CU cables drawn in 25mm dia. pvc conduits for the Bed head unit - Critical Power Supply line 1</td>
<td></td>
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<tr>
<td></td>
<td>▪ 3X2.5sq mm pvc sc CU cables drawn in 25mm dia. pvc conduits for the Bed head unit - Critical Power Supply line 2</td>
<td></td>
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<tr>
<td></td>
<td>▪ 15A Round Pin Socket outlet</td>
<td></td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 45A Cooker Unit complete with connector</td>
<td></td>
<td>6</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>▪ 20A D.P. Switch for kitchen</td>
<td></td>
<td>12</td>
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</tr>
<tr>
<td></td>
<td>▪ 13A Single Standard Socket outlet for X-Ray Viewer</td>
<td></td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 15A SPN Spur Switched Socket outlet</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Allow for power supply to Door Holders &amp; Fire Dampers complete with LSZH fire resistant cabling and conduit work</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 32A SPN Isolator complete with 2x4.0 Sq mm pvc/swa/pvc CU Cable (approx. 25metres) and associated accessories for Bed Pan Washer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>The following specialized outlet points complete with 25mm diameter PVC Heavy gauge conduit and all accessories as specified:</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Twin Data Outlet complete with Conduit only &amp; Draw wire.</td>
<td></td>
<td>135</td>
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<tr>
<td></td>
<td>▪ TV outlet complete with Conduit only &amp; Draw wire</td>
<td></td>
<td>56</td>
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<tr>
<td></td>
<td>▪ Nurse call point Outlet complete with Conduit only &amp; draw wire</td>
<td></td>
<td>151</td>
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<td>▪ Security point Outlet complete with Conduit only &amp; draw wire</td>
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<tr>
<td></td>
<td>▪ Clock point Outlet complete with Conduit only &amp; draw wire</td>
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<td>64</td>
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<tr>
<td></td>
<td>▪ Speaker point Outlet complete with Conduit only &amp; draw wire</td>
<td></td>
<td>67</td>
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</tr>
<tr>
<td></td>
<td>▪ BMS point Outlet complete with Conduit only &amp; draw wire</td>
<td></td>
<td>24</td>
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<tr>
<td>F</td>
<td>Any other item to complete the installation in this section (Please state).</td>
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Total Carried Forward to Collection Page
### SECTION D.W. 6.0 TITLE: LIGHTING AND POWER INSTALLATION

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<tr>
<th>Item</th>
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<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
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<td>D.W.6.3a</td>
<td><strong>LIGHTING AND SMALL POWER INSTALLATION</strong></td>
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<td></td>
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<tr>
<td></td>
<td><strong>First Floor</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Supply and install the following complete as specified or approved equivalent:</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>A.</td>
<td>Lighting points wired in 1.5mm² pvc/sc copper cables drawn in 20mm diameter pvc heavy gauge conduits complete with switching accessories as shown on drawings.</td>
<td></td>
<td>599</td>
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<tr>
<td>B.</td>
<td>The following luminaires complete with rated lamps as specified:</td>
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<tr>
<td>B.1</td>
<td>• TYPE (J4) - IP65 38W, 240V 600 x 600mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>80</td>
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<tr>
<td></td>
<td>• Type (J4E) as J4 but with Emergency kit</td>
<td>No. E</td>
<td>38</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• TYPE (C) - IP65 38W, 240V 1200 x 300mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>59</td>
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<tr>
<td></td>
<td>• Type (CE) as C but with Emergency kit</td>
<td>No.</td>
<td>34</td>
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<td>B.2</td>
<td>• TYPE (WL) - IP65 38W, 240V 1200 x 300mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>19</td>
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<tr>
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<td>• Type (WLE) as WL but with Emergency kit</td>
<td>No.</td>
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<tr>
<td></td>
<td>• TYPE (B2) - 1200mm, 45W, IP20 Slim-line LED luminaire</td>
<td>No.</td>
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<tr>
<td></td>
<td>• Type (B2E) as B2 but with Emergency kit</td>
<td>No.</td>
<td>20</td>
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<td>B.3</td>
<td>• TYPE (H12) - IP65 60W, 240V 1200 x 600mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>12</td>
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</tr>
<tr>
<td></td>
<td>• Type (H12E) as H12 but with Emergency kit</td>
<td>No.</td>
<td>10</td>
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</tr>
<tr>
<td>B.4</td>
<td>• TYPE (L) - 16W IP65 rated, Surface mounted polycarbonate bulkhead luminaire</td>
<td>No.</td>
<td>9</td>
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</tr>
<tr>
<td></td>
<td>• Type (LE) as L but with Emergency kit</td>
<td>No.</td>
<td>11</td>
<td></td>
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<tr>
<td></td>
<td>• TYPE (N) - 12W LED, IP54 Low Profile Surface Mounted luminaire fitted with microwave sensor</td>
<td>No.</td>
<td>44</td>
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<tr>
<td></td>
<td>• TYPE (ML) - 10W LED, 1X600mm, IP54 Low Profile Surface Mounted luminaire fitted with microwave sensor</td>
<td>No.</td>
<td>16</td>
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<tr>
<td></td>
<td>• TYPE (D) - 16W Recessed Dimmable Down lighter complete with drivers</td>
<td>No.</td>
<td>3</td>
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</tr>
<tr>
<td></td>
<td>• Type (DE) as D but with Emergency kit</td>
<td>No.</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• TYPE (D2) - 15W LED Square Recessed Down lighter luminaire</td>
<td>No.</td>
<td>47</td>
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Total Carried Forward to Collection Page
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<th>Rate</th>
<th>KShs.</th>
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<tr>
<td>D.W.6.3a</td>
<td><strong>LIGHTING AND SMALL POWER INSTALLATION</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>First Floor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Type (D2E) as D2 but with Emergency kit</td>
<td>No.</td>
<td>12</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• TYPE (NL) -1.5W LED, 240V IP54 Stainless Steel Rectangular Recessed Wall Luminaire</td>
<td>No.</td>
<td>22</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>• TYPE (X) -12W, Surface Mounted Builkhead with die cast black AL Body luminaire</td>
<td>No.</td>
<td>7</td>
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<tr>
<td></td>
<td>• TYPE (G) -30W, IP65 Slim Profile LED External Wall, wall bracket luminaire</td>
<td>No.</td>
<td>26</td>
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</tr>
<tr>
<td></td>
<td>• Type Wall mounted One sided LED Emergency Exit Sign</td>
<td>No.</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Type ceiling mounted two sided LED Emergency Exit Sign</td>
<td>No.</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Examination Light @ 1200mm AFFFL</td>
<td>No.</td>
<td>4</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Allow for 15 metres of 24V DC IP68 RGB Flexible High Density LED Strip Light complete with transformer, control drivers and associated accessories</td>
<td>No.</td>
<td>13</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Allow for Operation Warning Light wired to machine (coordinate with supplier)</td>
<td>No.</td>
<td>6</td>
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</tr>
<tr>
<td></td>
<td>• Light Motion sensor (occupancy sensor).</td>
<td>No.</td>
<td>67</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>C</strong> 10A moulded ivory switch plate as cabtree or approved as follows;</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• One Gang One way Architrave switches</td>
<td>No.</td>
<td>154</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• One Gang One way (Dimmer) Architrave switches</td>
<td>No.</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• One Gang Two way Architrave switches</td>
<td>No.</td>
<td>4</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Two Gang One way Architrave switches</td>
<td>No.</td>
<td>3</td>
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</tr>
<tr>
<td></td>
<td>• Two Gang Two way Architrave switches</td>
<td>No.</td>
<td>4</td>
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<tr>
<td></td>
<td>• Three Gang One way Architrave switches</td>
<td>No.</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>D</strong> The following power outlets complete with 25mm diameter PVC Heavy gauge conduits, all accessories and wiring as specified:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 13A Twin Standard Socket outlet in &quot;Blue&quot; Colour for Critical Power</td>
<td>No.</td>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 13A Twin Standard Socket outlet in &quot;White&quot; Colour for Normal power</td>
<td>No.</td>
<td>121</td>
<td></td>
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<tr>
<td></td>
<td>• 13A Twin Standard Socket outlet in &quot;RED&quot; Colour for clean power.</td>
<td>No.</td>
<td>50</td>
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</tr>
</tbody>
</table>

Total Carried Forward to Collection Page
### SECTION D.W. 6.0 TITLE: LIGHTING AND POWER INSTALLATION

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<tr>
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<th>KShs.</th>
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</table>
| D.W.6.3b | **LIGHTING AND SMALL POWER INSTALLATION**  
**First Floor - Cont'** |  |  |  |  |
| D | ▪ 3X2.5sq mm pvc sc CU cables drawn in 25mm dia. pvc conduits for the Bed head unit - Critical Power Supply line 1  
▪ 3X2.5sq mm pvc sc CU cables drawn in 25mm dia. pvc conduits for the Bed head unit - Critical Power Supply line 2  
▪ 3X4.0sq mm pvc sc CU cables drawn in 25mm dia. pvc conduits for the Pendant unit and theatres Medical Pendant- UPS Power Supply line 1  
▪ 3X4.0sq mm pvc sc CU cables drawn in 25mm dia. pvc conduits for the Pendant unit and theatres Medical Pendant- UPS Power Supply line 2  
▪ 15A Round Pin Socket outlet  
▪ 45A Cooker Unit complete with connector  
▪ 20A D.P. Switch for kitchen  
▪ 13A Single Standard Socket outlet for X-Ray Viewer  
▪ 15A SPN Spur Switched Socket outlet  
▪ Allow for power supply to Door Holders & Fire Dampers complete with LSZH fire resistant cabling and conduit work  
▪ 32A SPN Isolator complete with 2x4.0 Sq mm pvc/swa/pvc CU Cable (approx. 25metres) and associated accessories for Bed Pan Washer | No. | 21 | 27 | 2 |
| E | The following specialized outlet points complete with 25mm diameter PVC Heavy gauge conduit and all accessories as specified:  
▪ Twin Data Outlet complete with Conduit only & Draw wire.  
▪ TV outlet complete with Conduit only & Draw wire  
▪ Nurse call point Outlet complete with Conduit only & draw wire  
▪ Security point Outlet complete with Conduit only & draw wire.  
▪ Clock point Outlet complete with Conduit only & draw wire.  
▪ Speaker point Outlet complete with Conduit only & draw wire. | No. | 123 | 11 | 118 |
| F | Any other item to complete the installation in this section (Please state). | Sum |  |  |  |

Total Carried Forward to Collection Page
## SECTION D.W. 6.0 TITLE: LIGHTING AND POWER INSTALLATION

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</tr>
<tr>
<td></td>
<td><strong>Second Floor</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Supply and install the following complete as specified or approved equivalent:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>Lighting points wired in 1.5mm² pvc/sc copper cables drawn in 20mm diameter pvc heavy gauge conduits complete with switching accessories as shown on drawings.</td>
<td></td>
<td>663</td>
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<tr>
<td>B.</td>
<td>The following luminaires complete with rated lamps as specified:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• TYPE (J4) - IP65 38W, 240V 600 x 600mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>11</td>
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<tr>
<td></td>
<td>• Type (J4E) as J4 but with Emergency kit</td>
<td>No.</td>
<td>8</td>
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<tr>
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<td>• TYPE (C) - IP65 38W, 240V 1200 x 300mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>36</td>
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<td>• Type (CE) as C but with Emergency kit</td>
<td>No.</td>
<td>13</td>
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<td>• TYPE (WL) - IP65 38W, 240V 1200 x 300mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>42</td>
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<tr>
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<td>• Type (WLE) as WL but with Emergency kit</td>
<td>No.</td>
<td>42</td>
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<tr>
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<td>• TYPE (P) -16W IP65 rated, Surface mounted polycarbonate bulkhead luminaire fitted with microwave sensor</td>
<td>No.</td>
<td>15</td>
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<tr>
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<td>• TYPE (B2)1200mm, 45W, IP20 Slim-line LED luminaire</td>
<td>No.</td>
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<td>• Type (B2E) as B2 but with Emergency kit</td>
<td>No.</td>
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<td>• TYPE (L) - 16W IP65 rated, Surface mounted polycarbonate bulkhead luminaire</td>
<td>No.</td>
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<tr>
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<td>• Type (LE) as L but with Emergency kit</td>
<td>No.</td>
<td>2</td>
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<td>• TYPE (N) -12W LED, IP54 Low Profile Surface Mounted luminaire fitted with microwave sensor</td>
<td>No.</td>
<td>51</td>
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</tr>
<tr>
<td></td>
<td>• TYPE (ML) -10W LED, 1X600mm, IP54 Low Profile Surface Mounted luminaire fitted with microwave sensor</td>
<td>No.</td>
<td>44</td>
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</tr>
<tr>
<td></td>
<td>• TYPE (D) - 16W Recessed Dimmable Down lighter complete with drivers</td>
<td>No.</td>
<td>17</td>
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</tr>
<tr>
<td></td>
<td>• Type (DE) as D but with Emergency kit</td>
<td>No.</td>
<td>8</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>• TYPE (D2) - 15W LED Square Recessed Down lighter luminaire</td>
<td>No.</td>
<td>54</td>
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<th>Rate</th>
<th>KShs.</th>
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<td><strong>Second Floor - Cont'</strong></td>
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<tr>
<td>B</td>
<td>• Type (D2E) as D2 but with Emergency kit</td>
<td>No.</td>
<td>12</td>
<td></td>
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<tr>
<td></td>
<td>• TYPE (NL) -1.5W LED, 240V IP54 Stainless Steel Rectangular Recessed Wall Luminaire</td>
<td>No.</td>
<td>113</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>• TYPE (X) -12W, Surface Mounted Bulkhead with die cast black AL Body luminaire</td>
<td>No.</td>
<td>7</td>
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</tr>
<tr>
<td></td>
<td>• TYPE (G) -30W, IP65 Slim Profile LED External Wall wall bracket luminaire</td>
<td>No.</td>
<td>10</td>
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</tr>
<tr>
<td></td>
<td>• Type Wall mounted One sided LED Emergency Exit Sign</td>
<td>No.</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Type ceiling mounted two sided LED Emergency Exit Sign</td>
<td>No.</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Light Motion sensor (occupancy sensor).</td>
<td>No.</td>
<td>71</td>
<td></td>
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<tr>
<td></td>
<td>• Bed Head Luminaire</td>
<td>No.</td>
<td>82</td>
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<tr>
<td>C</td>
<td>10A moulded ivory switch plate as cabtree or approved as follows;</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• One Gang One way Architrave switches</td>
<td>No.</td>
<td>86</td>
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</tr>
<tr>
<td></td>
<td>• One Gang One way (Dimmer) Architrave switches</td>
<td>No.</td>
<td>6</td>
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</tr>
<tr>
<td></td>
<td>• One Gang Two way Architrave switches</td>
<td>No.</td>
<td>4</td>
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<tr>
<td></td>
<td>• Two Gang One way Architrave switches</td>
<td>No.</td>
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<tr>
<td></td>
<td>• Two Gang Two way Architrave switches</td>
<td>No.</td>
<td>4</td>
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<tr>
<td></td>
<td>• Three Gang One way Architrave switches</td>
<td>No.</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>The following power outlets complete with 25mm diameter PVC Heavy gauge conduits, all accessories and wiring as specified:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 13A Twin Standard Socket outlet in &quot;Blue&quot; Colour for Critical Power</td>
<td>No.</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 13A Twin Standard Socket outlet in &quot;White&quot; Colour for Normal power</td>
<td>No.</td>
<td>143</td>
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</tr>
<tr>
<td></td>
<td>• 13A Twin Standard Socket outlet in &quot;RED&quot; Colour for clean power.</td>
<td>No.</td>
<td>141</td>
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<tr>
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<td>• 3X2.5sq mm pvc sc CU cables drawn in 25mm dia. pvc conduits for the Bed head unit - Critical Power Supply line</td>
<td>No.</td>
<td>80</td>
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<tr>
<td></td>
<td>• 3X2.5sq mm pvc sc CU cables drawn in 25mm dia. pvc conduits for the Bed head unit - UPS Power Supply line</td>
<td>No.</td>
<td>80</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>• 15A Round Pin Socket outlet</td>
<td>No.</td>
<td>2</td>
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Total Carried Forward to Collection Page
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<td>D.W.6.4c</td>
<td><strong>LIGHTING AND SMALL POWER INSTALLATION</strong>&lt;br&gt;<strong>Second Floor - Cont'</strong></td>
<td></td>
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</tr>
<tr>
<td>D</td>
<td>• 45A Cooker Unit complete with connector</td>
<td>No.</td>
<td>2</td>
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<tr>
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<td>• 20A D.P. Switch for kitchen</td>
<td>No.</td>
<td>2</td>
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<tr>
<td></td>
<td>• 13A Single Standard Socket outlet for X-Ray Viewer</td>
<td>No.</td>
<td>4</td>
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<tr>
<td></td>
<td>• 15A SPN Spur Switched Socket outlet</td>
<td>No.</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Allow for power supply to Door Holders &amp; Fire Dampers complete with LSZH fire resistant cabling and conduit work</td>
<td>No.</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 32A SPN Isolator complete with 2x4.0 Sq mm pvc/swa/pvc CU Cable (approx. 25metres) and associated accessories for Bed Pan Washer</td>
<td>No.</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>The following specialized outlet points complete with 25mm diameter PVC Heavy gauge conduit and all accessories as specified:</td>
<td>No.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Twin Data Outlet complete with Conduit only &amp; Draw wire.</td>
<td>132</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• TV outlet complete with Conduit only &amp; Draw wire</td>
<td>89</td>
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<td></td>
<td>• Nurse call point Outlet complete with Conduit only &amp; draw wire</td>
<td>263</td>
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<td></td>
<td>• Security point Outlet complete with Conduit only &amp; draw wire</td>
<td>31</td>
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<tr>
<td></td>
<td>• Clock point Outlet complete with Conduit only &amp; draw wire.</td>
<td>23</td>
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</tr>
<tr>
<td></td>
<td>• Speaker point Outlet complete with Conduit only &amp; draw wire.</td>
<td>35</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• BMS point Outlet complete with Conduit only &amp; draw wire.</td>
<td>25</td>
<td></td>
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</tr>
<tr>
<td>F</td>
<td>Any other item to complete the installation in this section (Please state).</td>
<td>Sum</td>
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Total Carried Forward to Collection Page

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### SECTION D.W. 6.0 TITLE: LIGHTING AND POWER INSTALLATION

<table>
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<tr>
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<th>Unit</th>
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<td>D.W.6.5a</td>
<td>LIGHTING AND SMALL POWER INSTALLATION</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>Third Floor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Supply and install the following complete as specified or approved equivalent:</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>The following Lighting Points complete with 20mm diameter HG PVC conduits, draw wire and accessories only <em>(Wiring and luminaires omitted)</em> as specified and shown on the contract drawings:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• TYPE (J4) - IP65 38W, 240V 600 x 600mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>65</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Type (J4E) as J4 but with Emergency kit</td>
<td>No.</td>
<td>25</td>
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</tr>
<tr>
<td></td>
<td>• TYPE (C) - IP65 38W, 240V 1200 x 300mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>35</td>
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</tr>
<tr>
<td></td>
<td>• Type (CE) as C but with Emergency kit</td>
<td>No.</td>
<td>14</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• TYPE (WL) - IP65 38W, 240V 1200 x 300mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Type (WLE) as WL but with Emergency kit</td>
<td>No.</td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• TYPE (P) -16W IP65 rated, Surface mounted polycarbonate bulkhead luminaire fitted with microwave sensor</td>
<td>No.</td>
<td>14</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>• TYPE (B2)1200mm, 45W, IP20 Slim-line LED luminaire</td>
<td>No.</td>
<td>5</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>• Type (B2E) as B2 but with Emergency kit</td>
<td>No.</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• TYPE (L) - 16W IP65 rated, Surface mounted polycarbonate bulkhead luminaire</td>
<td>No.</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Type (LE) as L but with Emergency kit</td>
<td>No.</td>
<td>5</td>
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<tr>
<td></td>
<td>• TYPE (N) -12W LED, IP54 Low Profile Surface Mounted luminaire fitted with microwave sensor</td>
<td>No.</td>
<td>57</td>
<td></td>
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<tr>
<td></td>
<td>• TYPE (ML) -10W LED, 1X600mm, IP54 Low Profile Surface Mounted luminaire fitted with microwave sensor</td>
<td>No.</td>
<td>53</td>
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<tr>
<td></td>
<td>• TYPE (D) - 16W Recessed Dimmable Down lighter complete with drivers</td>
<td>No.</td>
<td>19</td>
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<tr>
<td></td>
<td>• Type (DE) as D but with Emergency kit</td>
<td>No.</td>
<td>7</td>
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<tr>
<td></td>
<td>• TYPE (D2) - 15W LED Square Recessed Down Lighter luminaire</td>
<td>No.</td>
<td>49</td>
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<tr>
<td></td>
<td>• Type (D2E) as D2 but with Emergency kit</td>
<td>No.</td>
<td>9</td>
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</table>

Total Carried Forward to Collection Page
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<tr>
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<th>KShs.</th>
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<tr>
<td>D.W.6.5b</td>
<td><strong>LIGHTING AND SMALL POWER INSTALLATION</strong>&lt;br&gt;<strong>Third Floor - Cont'</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A-Cont’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• TYPE (NL) -1.5W LED, 240V IP54 Stainless Steel Rectangular Recessed Wall Luminaire</td>
<td></td>
<td>81</td>
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</tr>
<tr>
<td></td>
<td>• TYPE (X) -12W, Surface Mounted Bulbhead with die cast black AL Body luminaire</td>
<td></td>
<td>7</td>
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</tr>
<tr>
<td></td>
<td>• Type Wall mounted One sided LED Emergency Exit Sign</td>
<td></td>
<td>9</td>
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</tr>
<tr>
<td></td>
<td>• Type ceiling mounted two sided LED Emergency Exit Sign</td>
<td></td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Light Motion sensor (occupancy sensor).</td>
<td></td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Bed Head Luminaire</td>
<td></td>
<td>54</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. The following Light Switching Points complete with 20mm diameter HG PVC conduits, draw wire and accessories only (Wiring and Switches omitted) as specified and shown on the contract drawings:</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• One Gang One way Architrave switches</td>
<td></td>
<td>101</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• One Gang One way (Dimmer) Architrave switches</td>
<td></td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• One Gang Two way Architrave switches</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Two Gang One way Architrave switches</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Two Gang Two way Architrave switches</td>
<td></td>
<td>4</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Three Gang One way Architrave switches</td>
<td></td>
<td>12</td>
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<tr>
<td></td>
<td>C. The following Power Points complete with 25mm diameter HG PVC conduits, draw wire and accessories only (Wiring and Switches omitted) as specified and shown on the contract drawings:</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>• 13A Twin Standard Socket outlet in &quot;Blue&quot; Colour for Critical Power</td>
<td></td>
<td>43</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 13A Twin Standard Socket outlet in &quot;White&quot; Colour for Normal power</td>
<td></td>
<td>92</td>
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<tr>
<td></td>
<td>• 13A Twin Standard Socket outlet in &quot;RED&quot; Colour for clean power.</td>
<td></td>
<td>150</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>• 3X2.5sq mm PVC sc CU cables drawn in 25mm dia. PVC conduits for the Bed head unit - Critical Power Supply line</td>
<td></td>
<td>52</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 3X2.5sq mm PVC sc CU cables drawn in 25mm dia. PVC conduits for the Bed head unit - UPS Power Supply line</td>
<td></td>
<td>52</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 15A Round Pin Socket outlet</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 45A Cooker Unit complete with connector</td>
<td></td>
<td>2</td>
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Total Carried Forward to Collection Page
## SECTION D.W. 6.0 TITLE: LIGHTING AND POWER INSTALLATION

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<th>KShs.</th>
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<td><strong>D.W.6.5b</strong></td>
<td><strong>LIGHTING AND SMALL POWER INSTALLATION</strong>&lt;br&gt;<strong>Third Floor - Cont'</strong></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>C- Cont'</strong></td>
<td><strong>▪ 20A D.P. Switch for kitchen</strong></td>
<td>No.</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>▪ 13A Single Standard Socket outlet for X-Ray Viewer</strong></td>
<td>No.</td>
<td>4</td>
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<tr>
<td></td>
<td><strong>▪ 15A SPN Spur Switched Socket outlet</strong></td>
<td>No.</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>▪ Allow for power supply to Door Holders &amp; Fire Dampers complete with LSZH fire resistant cabling and conduit work</strong></td>
<td>No.</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>D.</strong></td>
<td>The following specialized outlet points complete with 25mm diameter PVC Heavy gauge conduit and all accessories as specified:&lt;br&gt;▪ Twin Data Outlet complete with Conduit only &amp; Draw wire.</td>
<td>No.</td>
<td>135</td>
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<tr>
<td></td>
<td>▪ TV outlet complete with Conduit only &amp; Draw wire</td>
<td>No.</td>
<td>69</td>
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<td>▪ Nurse call point Outlet complete with Conduit only &amp; draw wire</td>
<td>No.</td>
<td>206</td>
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<tr>
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<td>▪ Security point Outlet complete with Conduit only &amp; draw wire.</td>
<td>No.</td>
<td>27</td>
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<tr>
<td></td>
<td>▪ Clock point Outlet complete with Conduit only &amp; draw wire.</td>
<td>No.</td>
<td>21</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>▪ Speaker point Outlet complete with Conduit only &amp; draw wire.</td>
<td>No.</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E.</strong></td>
<td>Any other item to complete the installation in this section (Please state).</td>
<td>Sum</td>
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<td>D.W.6.6a</td>
<td><strong>LIGHTING AND SMALL POWER INSTALLATION</strong></td>
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<tr>
<td></td>
<td><strong>Fourth Floor</strong></td>
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<td></td>
<td>Supply and install the following complete as specified or approved equivalent:</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>The following Lighting Points complete with 20mm diameter HG PVC conduits, draw wire and accessories only <em>(Wiring and luminaires omitted)</em> as specified and shown on the contract drawings:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ TYPE (J4) - IP65 38W, 240V 600 x 600mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Type (J4E) as J4 but with Emergency kit</td>
<td>No.</td>
<td>5</td>
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<tr>
<td></td>
<td>▪ TYPE (C) - IP65 38W, 240V 1200 x 300mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>20</td>
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</tr>
<tr>
<td></td>
<td>▪ Type (CE) as C but with Emergency kit</td>
<td>No.</td>
<td>6</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>▪ TYPE (WL) - IP65 38W, 240V 1200 x 300mm LED Light Panel Luminaire</td>
<td>No.</td>
<td>15</td>
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</tr>
<tr>
<td></td>
<td>▪ Type (WLE) as WL but with Emergency kit</td>
<td>No.</td>
<td>15</td>
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</tr>
<tr>
<td></td>
<td>▪ TYPE (P) -16W IP65 rated, Surface mounted polycarbonate bulkhead luminaire fitted with microwave sensor</td>
<td>No.</td>
<td>8</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>▪ TYPE (B2)1200mm, 45W, IP20 Slim-line LED luminaire</td>
<td>No.</td>
<td>3</td>
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<tr>
<td></td>
<td>▪ Type (B2E) as B2 but with Emergency kit</td>
<td>No.</td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td>▪ TYPE (R2)-1500mm, 60W LED, IP65 Polycarbonate Triple Ant-corrosive luminaire</td>
<td>No.</td>
<td>15</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>▪ Type (R2E) as R2 but with Emergency kit</td>
<td>No.</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ TYPE (L) - 16W IP65 rated, Surface mounted polycarbonate bulkhead luminaire</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Type (LE) as L but with Emergency kit</td>
<td>No.</td>
<td>2</td>
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</tr>
<tr>
<td></td>
<td>▪ TYPE (N) -12W LED, IP54 Low Profile Surface Mounted luminaire fitted with microwave sensor</td>
<td>No.</td>
<td>28</td>
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<tr>
<td></td>
<td>▪ TYPE (ML) -10W LED, 1X600mm, IP54 Low Profile Surface Mounted luminaire fitted with microwave sensor</td>
<td>No.</td>
<td>25</td>
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<tr>
<td></td>
<td>▪ TYPE (D) - 16W Recessed Dimmable Down lighter complete with drivers</td>
<td>No.</td>
<td>5</td>
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</tbody>
</table>

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## SECTION D.W. 6.0 TITLE: LIGHTING AND POWER INSTALLATION

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<tr>
<th>Item</th>
<th>Description</th>
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<th>Rate</th>
<th>KShs.</th>
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<tr>
<td>D.W.6.6b</td>
<td><strong>LIGHTING AND SMALL POWER INSTALLATION</strong></td>
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<td></td>
<td><strong>Fourth Floor - cont'</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>A Cont'</td>
<td>▪ Type (DE) as D but with Emergency kit</td>
<td>No.</td>
<td>1</td>
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<tr>
<td></td>
<td>▪ TYPE (D2) - 15W LED Square Recessed Down Lighter luminaire</td>
<td>No.</td>
<td>49</td>
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<tr>
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<td>▪ Type (D2E) as D2 but with Emergency kit</td>
<td>No.</td>
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<td></td>
<td>▪ TYPE (NL) -1.5W LED, 240V IP54 Stainless Steel Rectangular Recessed Wall Luminaire</td>
<td>No.</td>
<td>58</td>
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<tr>
<td></td>
<td>▪ TYPE (X) -12W, Surface Mounted Bulkhead with die cast black AL Body luminaire</td>
<td>No.</td>
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<tr>
<td></td>
<td>▪ TYPE (G) -30W, IP65 Slim Profile LED External Wall wall bracket luminaire</td>
<td>No.</td>
<td>12</td>
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<td></td>
<td>▪ Type Wall mounted One sided LED Emergency Exit Sign</td>
<td>No.</td>
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<tr>
<td></td>
<td>▪ Type ceiling mounted two sided LED Emergency Exit Sign</td>
<td>No.</td>
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<tr>
<td></td>
<td>▪ Bed Head Luminaire</td>
<td>No.</td>
<td>30</td>
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<tr>
<td></td>
<td>▪ Light Motion sensor (occupancy sensor).</td>
<td>No.</td>
<td>35</td>
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<tr>
<td>B.</td>
<td>The following Light Switching Points complete with 20mm diameter HG PVC conduits, draw wire and accessories only (Wiring and Switches omitted) as specified and shown on the contract drawings:</td>
<td></td>
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<tr>
<td></td>
<td>▪ One Gang One way Architrave switches</td>
<td>No.</td>
<td>52</td>
<td></td>
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<tr>
<td></td>
<td>▪ One Gang One way (Dimmer) Architrave switches</td>
<td>No.</td>
<td>3</td>
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<tr>
<td></td>
<td>▪ One Gang Two way Architrave switches</td>
<td>No.</td>
<td>1</td>
<td></td>
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<tr>
<td></td>
<td>▪ Two Gang One way Architrave switches</td>
<td>No.</td>
<td>13</td>
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<tr>
<td></td>
<td>▪ Three Gang One way Architrave switches</td>
<td>No.</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>C.</td>
<td>The following Power Points complete with 25mm diameter HG PVC conduits, draw wire and accessories only (Wiring and Switches omitted) as specified and shown on the contract drawings:</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>▪ 13A Twin Standard Socket outlet in &quot;Blue&quot; Colour for Critical Power</td>
<td>No.</td>
<td>18</td>
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<tr>
<td></td>
<td>▪ 13A Twin Standard Socket outlet in &quot;White&quot; Colour for Normal power</td>
<td>No.</td>
<td>42</td>
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<tr>
<td></td>
<td>▪ 13A Twin Standard Socket outlet in &quot;RED&quot; Colour for clean power.</td>
<td>No.</td>
<td>53</td>
<td></td>
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<tr>
<td></td>
<td>▪ 3X2.5sq mm pvc sc CU cables drawn in 25mm dia. pvc conduits for the Bed head unit - Critical Power Supply line</td>
<td>No.</td>
<td>24</td>
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### SECTION D.W. 6.0 TITLE: LIGHTING AND POWER INSTALLATION

<table>
<thead>
<tr>
<th>Item</th>
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<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
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</table>
| **D.W.6.6b** | **LIGHTING AND SMALL POWER INSTALLATION**  
Fourth Floor - cont'                                            |      |     |      |       |
| C - Cont'   | • 3X2.5sq mm PVC sc CU cables drawn in 25mm dia. PVC conduits for the Bed head unit - UPS Power Supply line No. 24 |      |     |      |       |
|             | • 15A Round Pin Socket outlet No. 1                                                                  |      |     |      |       |
|             | • 45A Cooker Unit complete with connector No. 1                                                      |      |     |      |       |
|             | • 20A D.P. Switch for kitchen No. 1                                                                  |      |     |      |       |
|             | • 13A Single Standard Socket outlet for X-Ray Viewer No. 2                                           |      |     |      |       |
|             | • 15A SPN Spur Switched Socket outlet No. 2                                                          |      |     |      |       |
|             | • Allow for power supply to Door Holders & Fire Dampers complete with LSZH fire resistant cabling and conduit work No. 28 |      |     |      |       |
| D.          | The following specialized outlet points complete with 25mm diameter PVC Heavy gauge conduit and all accessories as specified: No. 55 |      |     |      |       |
|             | • Twin Data Outlet complete with Conduit only & Draw wire.                                           |      |     |      |       |
|             | • TV outlet complete with Conduit only & Draw wire No. 24                                             |      |     |      |       |
|             | • Nurse call point Outlet complete with Conduit only & draw wire No. 97                              |      |     |      |       |
|             | • Security point Outlet complete with Conduit only & draw wire No. 19                                 |      |     |      |       |
|             | • Clock point Outlet complete with Conduit only & draw wire No. 9                                     |      |     |      |       |
|             | • Speaker point Outlet complete with Conduit only & draw wire No. 22                                  |      |     |      |       |
|             | • BMS point Outlet complete with Conduit only & draw wire No. 27                                     |      |     |      |       |
| E.          | Any other item to complete the installation in this section (Please state).                          |      |     |      |       |

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## SECTION D.W. 6.0 TITLE: LIGHTING AND POWER INSTALLATION

<table>
<thead>
<tr>
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<td>COLLECTION PAGE</td>
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<tr>
<td>A.</td>
<td>Basement Level</td>
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</tr>
<tr>
<td>B.</td>
<td>Ground Floor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>First Floor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>Second Floor</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>E.</td>
<td>Third Floor</td>
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<tr>
<td>F.</td>
<td>Fourth Floor</td>
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SECTION D.W. 7.0 TITLE: CABLE MANAGEMENT SYSTEM

<table>
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<th>Rate</th>
<th>KShs.</th>
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<td>D.W.7</td>
<td><strong>CABLE MANAGEMENT SYSTEMS</strong></td>
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<tr>
<td></td>
<td>For the supply and installation of the following complete as specified:</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>250 x 50mm² 2 compartment Metal trunking complete with external/internal angles, covers,</td>
<td>M</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>bends etc. as shown on contract drawings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>600 x 100mm Metal Cable Ladder complete with angles, bends etc. as shown on contract drawings</td>
<td>M</td>
<td>800</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>as follows.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>300 x 100mm H. G. Metal Cable Tray complete with angles, bends etc. as shown on contract</td>
<td>M</td>
<td>1400</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>drawings as follows.</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>200 x 75mm Metal Cable Tray complete with angles, bends etc. as shown on contract drawings</td>
<td>M</td>
<td>490</td>
<td></td>
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<tr>
<td></td>
<td>as follows.</td>
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<td></td>
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</tr>
<tr>
<td>E.</td>
<td>150 x 75mm Metal Cable Tray complete with angles, bends etc. as shown on contract drawings</td>
<td>M</td>
<td>130</td>
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<tr>
<td></td>
<td>as follows.</td>
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<td></td>
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<tr>
<td>F.</td>
<td>50mm dia. pvc heavy gauge conduits.</td>
<td>M</td>
<td>1000</td>
<td></td>
<td></td>
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<tr>
<td>G.</td>
<td>38mm dia. pvc heavy gauge conduits.</td>
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<td>2000</td>
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<tr>
<td>H.</td>
<td>25mm dia. pvc heavy gauge conduits.</td>
<td>M</td>
<td>2000</td>
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<tr>
<td>I.</td>
<td>Any other item necessary to complete the installation in this section (Please state)</td>
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## SECTION 8.0: TITLE: LIGHTNING PROTECTION SYSTEM

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<th>KShs.</th>
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<tr>
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<td>For the supply and installation of the following complete with associated accessories to complete the installation as specified and shown on the contract drawings:</td>
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<td></td>
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</tr>
<tr>
<td>A.</td>
<td>Copper type Earth electrode complete with test clamps.</td>
<td>No.</td>
<td>6</td>
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</tr>
<tr>
<td>B.</td>
<td>25 x 3mm lightning protection copper tape complete with saddles, clips etc. as specified in the Specification.</td>
<td>m</td>
<td>750</td>
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<tr>
<td>C.</td>
<td>3M Copper Rod Air termination spikes complete with base and clamp.</td>
<td>No.</td>
<td>8</td>
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<tr>
<td>D.</td>
<td>Concrete earthing inspection pits</td>
<td>No</td>
<td>8</td>
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<tr>
<td>E.</td>
<td>Allow a sum for testing and commissioning.</td>
<td>Sum</td>
<td></td>
<td></td>
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<tr>
<td>F.</td>
<td>Allow a sum for bonding all roof metal works and water tanks.</td>
<td>Sum</td>
<td></td>
<td></td>
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<tr>
<td>G.</td>
<td>Any other item necessary to complete the installation in this section (Please state)</td>
<td>Sum</td>
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**SECTION D.W. 9.0 TITLE: EXTERNAL LIGHTING SYSTEM**

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<td>For the supply and installation of the following complete with associated accessories to complete the installation as specified and shown on the contract drawings:</td>
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<tr>
<td>A.</td>
<td>The following luminaires complete with rated LED lamps as specified:</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>• Type (FL) 2x100W LED Floor Light complete with 4500mm Galvanized metal Pole, Solar Panel, Back up battery, Utility static bypass controller unit, PIR and Earthing System</td>
<td>No.</td>
<td>6</td>
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<tr>
<td></td>
<td>• TYPE (G) -30W, IP65 Slim Profile LED External Wall, wall bracket luminaire</td>
<td>No.</td>
<td>43</td>
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<tr>
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<td>• Type (SL) 1x45W Solar Powered LED Light Fitting complete with 2500mm Galvanized metal Pole, inbuilt Solar Powered System, PIR and Earthing System</td>
<td>No.</td>
<td>14</td>
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</tr>
<tr>
<td></td>
<td>• Type (Z) 1000mm, 45W, IP54 Economical, vandal-resistant bollard for ground- mounting applications as PHILLIPS - Vivara LED</td>
<td>No.</td>
<td>39</td>
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<tr>
<td></td>
<td>• Type (Z1) 28W LED Ball Type Fitting mounted at Gate wall</td>
<td>No.</td>
<td>6</td>
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<td>B.</td>
<td>Supply and installation of the following power cables complete with 50mm diameter HG PVC conduit as specified</td>
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<tr>
<td></td>
<td>• 4 x 6mm2 xlpe/swa/pvc 4core copper cable</td>
<td>M</td>
<td>900</td>
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<tr>
<td></td>
<td>• 2.5 pvc twin with earth (TWE) copper cable</td>
<td>M</td>
<td>1300</td>
<td></td>
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<tr>
<td>C.</td>
<td>Feeder Pillar comprising of 7 way TPN Distribution Unit for External Lighting incorporating 4x10 Amps SP ELCBs, spares and External Lighting Contactor with override switch and Photo-cell complete with associate accessories</td>
<td>No.</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>Allow for 10A Photocell complete with override switch, contactors and associated wiring for external lighting</td>
<td>No.</td>
<td>8</td>
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<tr>
<td>E.</td>
<td>Any other item necessary to complete the installation in this section (Please state)</td>
<td>Sum</td>
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Total Carried to Main Summary Page.
### SECTION D.W. 10.0 TITLE: FIRE DETECTION & ALARM SYSTEM

<table>
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<tr>
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<th>Unit</th>
<th>Qty</th>
<th>Rate</th>
<th>KShs.</th>
</tr>
</thead>
</table>
| **D.W.10.1** | **FIRE DETECTION AND ALARM SYSTEM**  
For the supply and installation of the following complete with associated accessories to complete the installation as specified and shown on the contract drawings: | | | | |
| | A. 23 Zones, 7 Loops Analogue Addressable fire detection and alarm panel complete with printer and with associated accessories. | No. | 1 | | |
| | B. Analogue Addressable fire Repeater panel complete with associated accessories. | No. | 1 | | |
| | C. Combined Ionization and Photoelectric type Analogue Addressable smoke detector mounted on ceiling or on walls complete with 25mm diameter HG PVC conduit work and LSZH fire resistant cabling as specified and shown on the contract drawings as follows:  
- Basement Floor  
- Ground Floor  
- First Floor  
- Second Floor  
- Third Floor (25mm diameter HG PVC conduits, draw wire and accessories only ([Wiring and Devices omitted]))  
- Fourth Floor (25mm diameter HG PVC conduits, draw wire and accessories only ([Wiring and Devices omitted])) | No. | 56 | | |
| | D. Analogue addressable heat detectors complete with 25mm diameter HG PVC conduit work and LSZH fire resistant cabling as specified and shown on the contract drawings as follows:  
- Basement Floor  
- Ground Floor  
- First Floor  
- Second Floor  
- Third Floor (25mm diameter HG PVC conduits, draw wire and accessories only ([Wiring and Devices omitted]))  
- Fourth Floor (25mm diameter HG PVC conduits, draw wire and accessories only ([Wiring and Devices omitted])) | No. | 19 | 2 | 1 | 2 | 4 | 1 |

Total Carried to Main Summary Page
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
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<td>D.W.10.2</td>
<td><strong>FIRE DETECTION AND ALARM SYSTEM - CONT'</strong></td>
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<tr>
<td></td>
<td>E. Analogue addressable fire alarm push button complete with 25mm diameter HG PVC conduit work and LSZH fire resistant cabling as specified and shown on the contract drawings as follows;</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>- Basement Floor No. 14</td>
<td>No.</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Ground Floor No. 11</td>
<td>No.</td>
<td>11</td>
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</tr>
<tr>
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<td>- First Floor No. 7</td>
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<td>7</td>
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</tr>
<tr>
<td></td>
<td>- Second Floor No. 6</td>
<td>No.</td>
<td>6</td>
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<tr>
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<td>- Third Floor (25mm diameter HG PVC conduits, draw wire and accessories only (<em>Wiring and Devices omitted</em>)) No. 7</td>
<td>No.</td>
<td>7</td>
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<tr>
<td></td>
<td>- Fourth Floor (25mm diameter HG PVC conduits, draw wire and accessories only (<em>Wiring and Devices omitted</em>)) No. 5</td>
<td>No.</td>
<td>5</td>
<td></td>
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<tr>
<td></td>
<td>F. Analogue Addressable Fire alarm combination bell/visual strobe complete with 25mm diameter HG PVC conduit work and LSZH fire resistant cabling as specified and shown on the contract drawings as follows;</td>
<td></td>
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<td>- Second Floor No. 6</td>
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<td>- Third Floor (25mm diameter HG PVC conduits, draw wire and accessories only (<em>Wiring and Devices omitted</em>)) No. 7</td>
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<td>- Fourth Floor (25mm diameter HG PVC conduits, draw wire and accessories only (<em>Wiring and Devices omitted</em>)) No. 5</td>
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<tr>
<td></td>
<td>G. Fire alarm visual strobe light complete with 25mm diameter HG PVC conduit work and LSZH fire resistant cabling as specified and shown on the contract drawings as follows;</td>
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<td>- Fourth Floor (25mm diameter HG PVC conduits, draw wire and accessories only (<em>Wiring and Devices omitted</em>)) No. 18</td>
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Total Carried to Main Summary Page
### SECTION D.W. 10.0 TITLE: FIRE DETECTION & ALARM SYSTEM

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<td><strong>FIRE DETECTION AND ALARM SYSTEM - CONT'</strong></td>
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<td>H.</td>
<td>Fire Door Holder complete with 25mm diameter HG PVC conduit work, 240Vac Power Supply system complete with armature, LSZH fire resistant cabling etc. as specified and shown on the contract drawings as follows (Coordinate with door supplier and approved by Architect)</td>
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<tr>
<td>I.</td>
<td>Allow for interconnection and interfacing with HVAC and mechanical equipment wired in 25mm diameter HG PVC conduit work, 240Vac Power Supply system, LSZH fire resistant cabling etc. as specified and shown on the contract drawings as follows (Coordinate with Air Conditioning supplier and approved by Engineers) as follows;</td>
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<td></td>
<td>- Ducts Concealed Smoke Detectors/HVAC Units</td>
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<td>J.</td>
<td>Supply and Install Fire Remote LCD Display unit 25mm diameter HG PVC conduit work, LSZH fire resistant cabling etc.</td>
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<tr>
<td>K.</td>
<td>Allow for programming of the alarm system as described in the fire alarm sequence of operation</td>
<td>Sum</td>
<td></td>
<td></td>
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<tr>
<td>L.</td>
<td>Allow for integration of the alarm system with other system like Power Distribution System, lifts/hoists, Security System, Public Address System and Nurses call system complete with interfacing modules, 25mm diameter HG PVC or/and Galvanized conduit works, LSZH fire resistant cabling etc. as described in the fire alarm sequence of operation (Coordinate with Equipment supplier and approved by Engineers)</td>
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<tr>
<td></td>
<td>Sum</td>
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Total Carried to Main Summary Page
### General Electrical Installations

#### Main Summary of Prices

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<th>KShs.</th>
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<tr>
<td>DW1.0</td>
<td><strong>SECTION 1</strong> Preliminaries &amp; Contractual Requirements</td>
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<td>DW2.0</td>
<td><strong>SECTION 2</strong> Incoming Electricity Supplies</td>
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<td>DW3.0</td>
<td><strong>SECTION 3</strong> Medium Voltage Equipment</td>
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<td>DW5.0</td>
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<td><strong>SECTION 6</strong> Lighting and Small Power Installations</td>
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<td>DW7.0</td>
<td><strong>SECTION 7</strong> Cable Management</td>
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<td>DW8.0</td>
<td><strong>SECTION 8</strong> Lightning Protection System</td>
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<td>DW9.0</td>
<td><strong>SECTION 9</strong> External Lighting System</td>
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<td>DW10.0</td>
<td><strong>SECTION 10</strong> Fire Detection and Alarm System Installation</td>
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**Sub Total**

Total Carried Forward to Main Summary of Volume I
PART L

TECHNICAL SCHEDULE
11.1 SWITCHGEARS TECHNICAL DATA SHEET

Environmental Conditions

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<td>Highest recorded temperature</td>
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</tr>
<tr>
<td>Average recorded temperature</td>
<td>°C</td>
</tr>
<tr>
<td>Lowest recorded temperature</td>
<td>°C</td>
</tr>
<tr>
<td>Highest recorded Humidity</td>
<td>%</td>
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<tr>
<td>Average Recorded Humidity</td>
<td>%</td>
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<tr>
<td>Lowest recorded Humidity</td>
<td>%</td>
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<tr>
<td>Corrosion conditions</td>
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Number of units and name tags

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<th>Drawing No.</th>
<th>Name tag</th>
<th>Assembly designation / Description</th>
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<td>(i)</td>
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<td>(ii)</td>
<td>EP_004.2</td>
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<td>(iii)</td>
<td>EP_004.3</td>
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### 11.2 Testing Requirements

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<tr>
<td>Routine Test – Functional and electrical operation test</td>
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<tr>
<td>Routine Test – Dielectric test</td>
<td>YES</td>
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</tr>
<tr>
<td>Routine Test – All relevant temperatures, pressures, flows, speeds</td>
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<tr>
<td>Routine Test – Checking of protective measures and of the electrical continuity of the protective circuits</td>
<td>YES</td>
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<tr>
<td>Routine Test – Insulation resistance</td>
<td>YES</td>
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<table>
<thead>
<tr>
<th>Type Test</th>
<th>Description</th>
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<tr>
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<tr>
<td>Type Test – Verification of the dielectric properties</td>
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<tr>
<td>Type Test – Verification of the short-circuit withstand strength</td>
<td>YES</td>
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<tr>
<td>Type Test – Verification of the effectiveness of the protective circuit (earthing and bonding)</td>
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<tr>
<td>Type Test – Verification of clearances and creepage distances</td>
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<tr>
<td>Type Test – Verification of the mechanical operation</td>
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<td>Type Test – Verification of the degree of protection (IP rating)</td>
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<table>
<thead>
<tr>
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<tbody>
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<td>Site Test – Insulation resistance</td>
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<tr>
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<td>(with dimensions)</td>
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<td>As-built Schematics</td>
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11.4 TECHNICAL SCHEDULE

The tenderer must submit comprehensive manufacturer's technical brochures and performance details for all items listed in this schedule.

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<tr>
<td>C</td>
<td>Copper busbars</td>
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<tr>
<td>D</td>
<td>Controls</td>
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</tr>
<tr>
<td>E</td>
<td>Copper cables</td>
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<td>F</td>
<td>Distribution Board</td>
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<td>Consumer Units</td>
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<td>TV outlets</td>
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<td>Q</td>
<td>Cable tray/cable ladder</td>
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<td>R</td>
<td>Fire detection system</td>
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<td>Fire Alarm Panel</td>
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<td>Sounders</td>
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PART M:

DRAWING SCHEDULE
12.1 DRAWING SCHEDULE:

As shall be provided during tendering process.