PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS

FOR

NATIONAL SOCIAL SECURITY FUND (NSSF)

TENDER REF NO: NSSF/ONT/BW/24/2025/26

VOLUME 3 OF 5

ELECTRICAL SERVICES INSTALLATIONS

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JUNE, 2026

PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS

FOR

NATIONAL SOCIAL SECURITY FUND (NSSF)

VOLUME 3 OF 5

BILLS OF QUANTITIES

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JUNE, 2026

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NATIONAL SOCIAL SECURITY FUND (NSSF)

CONTRACT FOR THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NATIONAL SOCIAL SECURITY FUNDELECTRICAL INSTALLATIONS

SPECIAL NOTES FOR ALL TENDERERS:

1. These notes shall form part of these specifications and conditions.

2. The tenderer is required to check the number of pages in this document and should any be found to be missing or the figures indistinct, he must inform the Engineers at once and have the same rectified. Should the tenderer be in doubt about the precise meaning of any item, word or figures, or for any reason whatsoever observe any apparent omission of words or figures, he must inform the Engineer in order that the correct meaning may be decided upon before the date for the submission of the tenders.

3. No liability whatsoever will be admitted nor claim allowed in respect of errors in the completed tender due to mistakes in this document which should have been rectified in the manner described above.

4. The tenderer shall not alter or otherwise qualify the text of this specification. Any alteration or qualification made without authority will be ignored and the text of the specification as printed will be adhered to.

5. The tenderer shall be deemed to have made allowances in his unit prices generally to cover items of preliminaries or additions to Prime cost Sums or other items, if those have not been priced against the respective items.

6. The tenderer's price shall include all government taxes including duties, V.A.T. etc. No claims whatsoever will be allowed in respect of duties, VAT e.t.c if the tenderer fails to include them in his unit prices. It is also to be noted that VAT will be included in the unit rates and NOT worked out as a percentage of the total.

7. In no case will any expenses incurred by the tenderer in preparation of this tender be reimbursed.

8. The copyright of this specification is vested in the Engineers and no part thereof may be reproduced without their express permission, given in writing.

9. The specifications must be priced in Kenya Currency i.e. Shillings and Cents.

10. All the tenderers must make a declaration that they have not and will not make any payment to any person which can be perceived as an inducement to enable them to win this tender.

Signed (As in Tender)..... Date/Stamp.....

SECTION I:

SECTION I – GENERAL AND PARTICULAR ELECTRICAL SPECIFICATIONS

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GENERAL ELECTRICAL SPECIFICATIONS

1.00 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.

1.01 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.
3) Regulations for the Electrical Equipment of Buildings issued by the Institution of Electrical Engineers of Britain (I.E.E.) with Kenya amendment.
4) The United Kingdom Chartered Institute of Building Services Engineers (CIBSE) Guide 'K' on electricity in Buildings.
5) The Factories Act for the Kenya Government.
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 Bylaws
8) The Employers Safety Regulations.
9) General Electrical Specifications (GES 1 & 2)

1.02 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.

1.03 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 theceiling. 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.

1.04 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.

1.05 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 demountables (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 manufacturers 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.

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

1.06 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^{o}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.

x) 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.

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

1.07 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.

1.08 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.

1.09 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

1.10 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.

1.11 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 heightof 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 aminimum thickness of 25mm and of concrete mix of 1:2:4. The tiles shall be labelled 'HATARI'. The cables shall belaid 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 it's 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)

1.12 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: -

Final Sub Circuit

Single phase		Cable insulation Colour	Cable end markers
a)	Phase	red	red
b)	Neutral	black	black
c)	Earth	green	green

Three Phase & Neutral

a)	Phase	red/yellow/blue	red
b)	Neutral	black	blue

Main & Sub Main

Single phase

a)	Phase	red	red
b)	Neutral	black	black
c)	Earth	green	green

Three Phase

Mains

a)	Phase	red	red
		Yellow	yellow
		Blue	blue
b)	Natural	black	black
c)	Earth	green	green

Three Phase & Neutral Multicore Cable

a)	Phase	red	red
		Yellow	yellow
		Blue	blue
b)	Neutral	black	black

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

SYSTEM		**INSULATION COLOURS**
Earthing		Green & yellow or green
Neutral		Blue
Phase	R-Red	Brown or Red
	Y-Yellow	Brown, White, Yellow
	B-Blue	Brown or Blue
	Neutral	Black

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.

1.13 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.

1.14 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 away 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.

1.15 SUB-CIRCUITS

(i) 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 4mm^2 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.

(ii) 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.

(iii) Lighting final sub-circuits

i) All lighting points shall be wired with cables not less than 1.5mm^2 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.

1.16 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 shallbe 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 caternary 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 70mm^2. 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.

1.17 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 $2.5mm^2$.

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.

iv) 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.

v) 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.

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1.18 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.

1.19 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 enamelled finish except where specified otherwise. Where installed externally or in damp conditions they shall be galvanized. Conduit fittings, accessories or equipment used in conjunctionwith 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 galvanised 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.

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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.

1.20 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.

1.21 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 equipments 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 appreance, painted, with full front or rear access or both, as called for in the particular specifications. It shall be suitable for indoor use, sectionalised 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 **10guage** 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 shownon 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 withstandtemperatures 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 swtichfuse 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.

1.22 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.

1.23 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.

1.24 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.

ii) 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.

1.25 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.

ii) 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 areto

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.

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.

ix) 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.

1.26 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.

1.27 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.

1.28 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 alivewhen 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.

1.29 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.

1.30 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 1.5mm^2. Where these cables are likely 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.

1.31 STREET SECURITY OUTDOOR LIGHTS & COLUMNS

i) The Street lighting support column shall be at minimum of 300mm depth in the ground on 100mmthick 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.

1.32 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 20^0 c to 45^0 c.

1.33 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.

1.34 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.

1.35 FLEXIBLE CORDS

i) Circular sheathed white twin TRS flex to BS: 6500:1989 shall be used for plain pendant fittings up to 100watts. 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 a short as possible where unavoidable.

iv) Care shall be taken to ensure the flexible cord does not support lighting fitting exceeding 3kg. 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 12Amps.

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

1.36 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.

1.37 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 Services 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

1.38 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".

1.39 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-arcing (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. **(1^2)** shall be the square of Ampere RMS value of **prospective short circuit fault level current** and **(t)** the time period in seconds.

1.40 RESIDUAL CURRENT CIRCUIT BREAKERS OR EARTHLEAKAGE 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.

1.41 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

1.42 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.

1.43 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.

(v) 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.

vi) MICs cables must be protected from mechanical damage by covering them when drawing them inshort 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.

vii) 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.

viii) 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.

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

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

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

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

1.44 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.

1.45 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, phasesequence 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 sequenceis maintained throughout the installation. Triplicate copies of the results of the above tests shall be provided within 14days 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 continuityconductor

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 impendence tests,

iv) Earth Electrode resistance tests.

h) Any apparent fault, defects or omission or faulty Workmanship, incorrectly positioned or installedparts 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 carryout the tests. The instruments and apparatus shall be made available to the services Engineer to enable him to carryout such tests as he may require. The contractor shall generally attend on other contractors employed on the project and carryout 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

PVC SWA PVC type having a rating of 600/1000 volts and manufactured to KS 04-194: 1988 and KS 04-187/188 with an overall extruded PVC insulation covering shall be manufactured dimensionally to B.S. 31/1940 BS 4607 part 1, 1970 or to KS 04-179 1979 Part 1.

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.

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

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.

STRUCTURED CABLING

SPECIFICATIONS

SECTION 1

QUALITY OF MATERIALS AND WORKMANSHIP

1. GENERAL

This section specifies the general requirements for plant, equipment and materials forming part of the Sub-contract and shall apply except where otherwise specified.

The Sub-contract works must be carried out strictly in accordance with the following documents:-

i) The Telkom Kenya Ltd. guidelines to contractors for Supply Installation and maintenance and Telecommunication wiring and terminal equipment.

ii) The Telkom Kenya Ltd. guidelines to contractors for supply, installation and maintenance of External Telecommunications wiring.

iii) The Licensee's by-laws.

iv) Relevant British Standard Specifications and Codes of Practice published by the British Standards Institution (hereinafter referred to as B.S. and C.P respectively). Relevant International Standards ISO, IEEE and ANSI

v) The specification

vi) The working drawings, produced by the Telecommunications Sub-contractor and approved by the Engineer.

vii) The Engineer's instructions.

The Telecommunications Sub-contractor shall undertake all modifications, demanded by the authorities in order to comply with the regulations, and produce all certificates, if any, from the authorities without extra charge.

Materials and/or apparatus supplied by others for installation and/or connection by the Telecommunications Sub-contractor shall be carefully examined on receipt. Should any defects be noted the Telecommunications Sub-contractor shall immediately notify the Consulting Engineer.

Unless otherwise specified all materials including equipment, fittings, cables, etc., shall be in new condition. Defective equipment or that damaged in course of installation or test shall be replaced or repaired to the approval of the Consulting Engineer. Should any replacement be necessary the Telecommunications Sub-contractor shall bear the cost of substitution of all associated builder's work and making good finishes.

It is particularly necessary that all the Telecommunications Sub-contractor's proposals and Working Drawings for and in connection with the works shall be submitted early in the Contract period to facilitate co-ordination with others.

All plants, apparatus, equipment, valves, distribution cabinets, terminals and cable cores shall be securely and properly labelled to the approval of the Engineer.

The labelling shall clearly show the identification of the circuit. Labels shall be of Traffalyte sheet or equal fixed with screws or rivets.

Uniformity of type and manufacture of fittings or accessories is to be preserved throughout the whole work.

The Telecommunications Sub-contractor will be entirely responsible for all materials, apparatus, equipment etc., furnished by him in connection with his work, and shall take all special care to protect all parts of finished work from damage until it is handed over to the Employer.

The work shall be carried out by competent workmen under skilled Supervision. The engineer shall have the authority to have any part of the work taken down or changed, which is executed in an unsatisfactory manner.

2. CROSS CONNECTION CABINET

Modular construction shall be used wherever practicable and provision Shall be made for simplified servicing, replacement and maintenance throughout without major dismantling.

All modules shall be of **Siemon** type and shall be labelled in agreement with the Engineer using engraved plastic labels.

Where spaces in cabinets are provided for future modules to be installed as shown on the drawings. Frames shall be provided and installed so that in the future modules may be installed and connected with the least possible inconvenience. The cabinet shall comprise modules, wiring, High Voltage Protectors and a suitable entry shall be provided at the bottom of the cabinet as appropriate.

All wiring within the cabinet shall be orderly laced and bonded to the cabinet structure, the wiring insulation being coloured according to the ISO Standards colour scheme.

Where wiring passes through holes in metalwork protection by rubber bushes shall be provided.

Cable entries shall be provided at the bottom end of the cabinet to allow for Telkom Kenya Ltd. Cable Connection.

Modules shall be left in place for the termination of the Telkom Kenya Ltd. cable.

Where wiring is installed by Telkom Kenya Ltd. to the cabinet, the final connection to the modules shall be carried out as part of this contract.

The cabinet shall be fitted internally with circuit lists and a schematic drawing showing the routing of the cable network mounted on a glazed frame.

3. CABLES

All cables shall be delivered to site in their original packing with all seals intact.

Cable dimensions shall conform to ISO Standards and with the information given on the drawings or in the specifications.

Cables in vertical runs shall be clamped in such a way that stresses in the cables are avoided.

Where no trays or trunking is installed the cables shall be fixed to structures by means of screw fixed saddles.

Common saddles shall be used where cables are grouped. All cables shall be terminated with suitable Box Terminals of the correct size.

Cable routes are indicated on the drawings for tender purposes but the exact final routes shall be agreed with the Consulting Engineer.

The Telecommunication Sub-contractor, who is to include for the supply and installation of all jointing materials, cable supports, steel racking and making all the necessary cable joints, shall carry out all work except builder's work. The cable shall be installed and tested in strict accordance with the appropriate clauses of the ISO Standards and CCK. specifications.

Cables shall at all times be handled with care and every effort made to avoid damage. Unloading, rolling to position and mounting of cable drums shall be carried out efficiently and carefully in the recognised manner and cable shall be pulled from the top of drum. Twisting shall at all times be avoided.

Adequate numbers of drum jacks, rollers and other handling accessories shall be used. Makeshift arrangements will not be tolerated. In all cases care shall be taken to break the rotation of the drum and cable shall bot be dragged over loose earth, concrete or any surface but shall be adequately supported on rollers or manhandled into position.

The Telecommunication Sub-contractor shall take particular care to avoid damage to other services, which may run adjacent, or across the route of the cable being installed.

Cables shall be installed with a minimum clearance as stated in the CCK guidelines to Contractors for Supply, Installation and Maintenance of External Telecommunications Wiring.

Where this condition is unavoidable or difficult to maintain the Sub-contractor may be called upon to divert or adjust the route of any cable so affected.

Aerial cables shall not be installed within a minimum clearance as stated in the Telkom Kenya Ltd. guidelines to Contractors for supply, Installation and Maintenance of External Telecommunication Wiring, Clause 14.6.1.

Trenching, laying, and backfilling will be carried out by the Telecommunications Sub-contractor.

Cables shall cross roads and enter buildings by means of 100mm diameter UPVC or similar non-corrosive pipes.

These shall be laid at minimum depth of 85mm and extended at a distance of 600mm on either sided of the road.

The Telecommunications Sub-contractor shall supply and install concrete marker posts at each cable entry into a building, each change of direction, each location of buried joints, each road or pathway crossing and throughout the length of the cable at intervals not exceeding 50 metres.

The position of all cable marker posts shall be agreed with the Architects and Consulting Engineers before installation.

The Main Contractor will supply UPVC ducts but it is the responsibility of the Telecommunications Sub-contractor to lay the ducts as indicated on the relevant drawings.

After the installation of cables all ducts shall be adequately sealed to prevent the ingress of moisture. The sealing substances shall be of the non-hardening type.

The Telecommunications Sub-contractor's attention is drawn to the fact that all cable sizes given in the Specification and/or Contract Drawings are based on the use of cables with copper conductors unless specifically specified to the contrary.

Through joints will only be allowed at runs exceeding the length to which cables can be manufactured.

4. BLOCK TERIMINALS

The Block Terminals will be provided in accordance with Telkom Kenya Ltd. Specifications.

Where modules are used this shall be of **SIEMON** type.

5. MDF

The MDF shall comprise of **SIEMON** type modules mounted of frames and suitable High Voltage protectors.

Modular construction shall be used and provision shall be made for simplified servicing, replacement and maintenance without major dismantling.

All wiring within the MDF shall be orderly, laced and bonded to the frame structure, the wiring insulation being coloured to the ISO standard colour scheme.

Cable entries shall be provided to allow for the entry of Underground cables with the appropriate number of modules being left in place to allow for the cable connection.

The MDF shall be fitted with circuit lists and a schematic drawing showing the cable routing.

8. BLOCK WIRING

Block wiring cables shall run from the MDF to the Floor Distributor. The cables shall be of approved telecommunication type, PVC sheathed and insulated. The Sub-contractor shall terminate the cables at both ends.

9. FLOOR DISTRIBUTOR

The Floor distributor shall comprise of **SIEMON** type or approved equivalent modules installed in wall mounted vertical frames inside the Telecommunications Riser Duct at each floor.

10. PRE-WIRING

Cables shall run from wall outlets to the Floor distributors. Wiring shall be carried out in an approved type of PVC sheathed and insulated cables as FTP Category 6A of the ISO/IEC 11801 Standards.

The colours of the cores shall comply with the colour code requirements of the ISO Standards.

Cables shall be drawn in at outlets, distribution cabinets and Block Terminals after the erection of the conduit system.

Under no circumstances shall it be permitted to draw cables into an incomplete section of the conduit installation. The wiring shall be carried out on the Block Terminals and Telecommunications outlets. No joints shall be made in boxes unless in approved transition points.

The cable shall run in the conduit so as not to exceed the capacities as set out in the IEEE/CCK Guidelines to Contractors for supply, installation and maintenance of Telecommunication Wiring and terminal equipment.

The arrangement and size of Telecommunication conduits shall be such as will accommodate the number of circuits as indicated on the contract drawings.

Where conduits enter adaptable boxes each conduit is to be numbered to indicate the outlet point which it feeds. Unless otherwise stated on the drawings, conduits will terminate in standard metal boxes to B.S 1363 with flush fitting twin RJ45 cover plate.

Draw-in boxes are required in telephone conduits as stated in the ISO Standards.

Telecommunication outlet boxes, draw-in boxes and the telecommunication distribution boxes are to be marked internally with yellow paint to distinguish them from boxes provided for other services.

11. CONDUIT, TRUNKING AND ASSOCIATED FITTINGS

Surface conduit shall be run in square symmetrical lines and shall be marked on site for approval before installation. Conduits shall be fixed by means of distance saddles spaced at not more than 1.2M (for 25mm diameter conduit) and 1.5M for larger sizes, for steel conduits and 0.9M for PVC conduits.

Sunken conduits run in chases in walls shall be fixed by means of mild steel pipe hooks or non-metallic saddles spaced not more than 0.9M. Where conduits are concealed behind plaster it shall be sunk to a depth of either 15mm below finished plaster level, or installed flush with the structural wall level before application of plaster, whichever is the lesser depth. Conduit cast-in-situ shall be frequently secured to the steel reinforcement work, with heavy binding wire to prevent movement of the conduit and conduit boxes during the pouring and vibrating of the concrete.

Outlet boxes shall be filled with paper to prevent ingress of concrete, and all boxes shall be securely fixed to the shuttering with nails, or by means which shall be visible as a marker on removal of the shuttering only. Conduit shall be installed after the first grid of steel reinforcement work is securely fixed and all open ends of conduit shall be protected by couplings plugged with a suitable non-metallic stopping plug. The number of right angle bends in conduit cast-in-situ shall not exceed two between boxes.

Conduits shall be installed after the first grid of steel reinforcement work is securely fixed and all open ends of conduit shall be protected by couplings plugged with a suitable non-metallic stopping plug. The number of right angle bends in conduit cast-in-situ shall not exceed two between boxes.

Where straight runs of conduit are installed, draw-in boxes shall be provided at distances not exceeding 15 Metres.Immediately prior to installing the wiring all conduit and fittings shall be dried and cleaned out by drawing through a cloth swab. Conduits shall be installed in such a manner as to prevent interference with other services and shall be kept at least 150mm clear gas or water pipes, and heat in excess of 70^0C.

Where conduit runs enter specified areas requiring flameproof equipment, barrier boxes shall be inserted immediately before the conduit enters the flameproof area. All conduits installed within this area shall be solid drawn galvanised, as shall be conduit fittings and accessories and Buxton Certified as suitable for Group 11 hazards, Equipment shall comply with B.S 229, B.S 889, and Code of Practice C.P 1003.

Steel-Conduits shall be of heavy gauge Class B Welded to British Standard Specification B.S 31. In no case will conduits smaller than 25 mm diameter 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 galvanised. Conduit fittings, accessories or equipment used in conjunction with galvanised conduits shall also be galvanised or otherwise as approved by theConsulting Engineer.

Plastic-Conduit shall be best quality new super high impact grade heavy gauge Class "A" rigid PVC unplasticesed conduit as or similar to manufacture Egatube Africa Ltd., suitable for plain connections or as specified.

The conduit shall be bent and formed strictly in accordance with the manufacturer's instructions. Small size i.e. 25 mm diameter shall be bent cold by inserting the correct size bending spring.

It is essential for right angle bends that the conduit is bent past 90^0 to allow for "spring back".

Larger sizes of conduits shall be pre-heated before inserting rubber cord to prevent kinking. Conduits badly formed or bent, or damaged in any way, shall not be used.

Joints shall be made watertight by the use of cement applied with a brush or rag. Cement shall be applied to the complete circumference of the conduit.

Conduits shall be thoroughly cleaned at the ends to ensure a good adhesion to the ends fittings. Cement shall not be permitted to enter into the conduit.

All conduit fittings and accessories including couplers, ordinary clips, saddles, pipe hooks, reducers, stopping plugs, locknuts and male and female bushes shall be manufactured dimensionally, similar to B.S 31/1940 where applicable. Solid tees shall not be used.

Solid inspection elbows or bends or inspection tees shall be used only in exceptional circumstances and then only with the approval of the Consulting Engineers.

A means of expansion shall be provided in conduit runs in excess of 10M without any bend or set, by use of expansion couplings, which shall be used at building expansion joint.

Metal trunking shall be fabricated from mild steel of not less than 18 SWG.

All sections of trunking shall be rigidly fixed together and attached to the framework or fabric of the building at intervals of not less than 1.2M. Joints in trunking shall not overhang `fixing points by more than 0.5M.

All trunking shall be made electrically continuous by means of 25x3 mm copper links across each joint and where the trunking is galvanised, the links shall be made by galvanised flat iron strips.

All trunking fittings (i.e. bends, tees, etc.,) shall leave the main trough completely clear of obstruction and 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 trunking passes through ceilings and walls the covers shall be solidly fixed to 150 mm either side of ceilings and floors and 50mm either side of walls.

Screws and bolts securing covers to trunking or sections of covers together shall be arranged so that damage to cables cannot occur either when fixing covers or when installing cables in the trough.

When trunking is used to connect Cabinets or Distribution, such connections shall be made by trunking fittings manufactured for this purpose and not by multiple conduit couplings.

When vertical sections of trunking are used which exceed 4.5M in length, staggered tie off points shall be provided at 4.5M intervals to support the weight of cables.

Unless otherwise stated, all trunking systems shall be painted as for conduit.

Cable tray shall be fabricated from perforated mild steel tray of minimum 14 SWG with return flanges and coupling pieces for rigidity and strength.

Unless otherwise stated in the Specification of Works the cable tray shall be painted grey enamel for indoor use and shall be hot dipped galvanised for outdoor locations.

Cable tray shall be appropriately fixed on robust and substantial brackets fixed into the walls or shall be suspended on rods securely fixed to the structure together with a bracket arrangement as required to facilitate the mild steel. Brackets of suspension supports shall be provided as necessary, the spacing of which shall not exceed 2.0M.

Where the cable tray changes direction the minimum radius of bends shall not be less than 300 mm on the inside of the bend and in no case shall it be less than bending radius of the cable supported.

All brackets, suspension rods and attachments shall be finished as the cable tray supported.

Fixing brackets for wall fixing shall be provided at not less than 1.8M intervals.

12. EARTHING

The earthing of the installation shall comply with the requirements laid down in IEE regulations.

An earth electrical system shall be installed at a point adjacent to the main MDF and at Every distribution Point. Each earth electrode shall be a 12 mm diameter copper rod driven to depth of 1300 mm. In rocky soil conditions, where depth is difficult to obtain, the Telecommunications Sub-Contractor shall obtain written approval from the Consulting Engineer for an alternative earth electrode system.

The electrode shall be connected via a green PVC insulated 25 sq.mm copper wire to an earth terminal adjacent to the MDF to which all cable armouring, conduit, trunking, Distribution Points etc., shall be bonded together.

Earthing arrangements and the resistance of the earth continuity conductor shall comply with IEE requirements.

Attention is drawn to the IEE Regulations to the effect that the resistance of the earth continuity conductor shall not exceed 0.5ohms.

13. TESTING ON SITE

The Telecommunications Sub-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 the current edition of the ISO Standards and CCK regulations.

Guidelines to Contractors for supply, installation and maintenance of Internal and External Telecommunication Wiring.

Tests shall be carried out to prove that all Telecommunications outlets are connected.

Tests shall be carried out on completion of the installation to ensure continuity throughout the installation. Triplicate copies of the results of the above tests shall be provided within 14 days of the witnessed tests and the Telecommunications Sub-contractor will be required to issue to the Consulting Engineer the requisite certificates upon completion as required by the Regulations refered to above.

Any faults, defects, or omissions or faulty workmanship, incorrectly positioned or installed parts of the installation made apparent by such inspections or tests shall be rectified by the Telecommunications Sub-Contractor at his own expense.

The Telecommunications Sub-Contractor shall provide accurate instruments and apparatus and all labour required to carry out the above tests.

The Sub-contractor shall test to the Consulting Engineer`s approval and as specified elsewhere in this Specification or in the Standards and Regulations already referred to, all equipment, plant and apparatus forming part of the net-work.

SECTION 2

PARTICULAR SPECIFICATION FOR STRUCTURED CABLING

1. EXTENT OF WORK

The work to be carried out under this Contract includes the supply on site, storage, delivery, installation, testing, replacement of broken items, protecting, cleaning, cut over and leaving in serviceable condition to the satisfaction of the Engineer, guarantee and maintenance in defects of the complete installation as herein specified on the drawings or as may be directed and shall include all such materials and equipment which, although not expressly specified are required and are necessary to complete the installation to the satisfaction of the Engineer.

The installation comprises the following items which are more fully described in other parts of this specifications.

The supply, installation and testing of:-

a) Main Distribution Frame

b) All Floor Distributions and Communication cabinets.

c) All earthing requirements.

d) All Block Wiring.

e) All Pre-Wiring.

f) All Telecommunication Outlets.

g) All earthing including earth electrodes, test clamps, earthing manholes, earthing and bonding leads.

2. TELEPHONE SERVICES

Incoming telephone services to the Main Distribution Frame shall be carried underground by Sub-Contractor registered with CAK.

Connection to the building shall be by an underground cable in accordance to the drawings.

All telecommunication wiring shall be carried out by the Telecommunication Sub-Contractor. Others shall install a 25mm diameter plastic conduit system with draw-wires from the telecommunications riser duct to the telecommunications outlets.

3. MANHOLES AND DUCTS

a) TELEPHONE MANHOLES AND DUCTS

All manholes and ducts shall be supplied and installed by others.

b) EARTHING MANHOLES

The standard earth electrode manholes shall be precast units with internal dimensions 450 x 450 x 300 deep. These shall be supplied and installed by the Telecommunication Sub-contractor.

4. INTERNAL CABLE INSTALLATION

The Telecommunications Sub-contractor shall allow for a complete cabling as shown on the drawings and confirm the following:-

a) All conduits to Telecommunications outlets shall be 25mm diameter PVC concealed in floors and walls of the building.

b) All Telecommunications outlet conduits shall provide easy passage for cables and shall have draw-wires left in position.

c) The Telecommunications outlet shall comprise a standard flush steel box complete with moulded Telecommunications outlet plate as Siemon mounted at 300mm a.f.f.l. All adaptable boxes shall be standard switch boxes complete withcover.

The Telecommunications Sub-contractor shall allow for cabling to facilitate the connection of computer equipment (PCs, printers, etc.) and telephones by others to every network wall outlet.

The Telecommunication Sub-Contractor shall provide twin RJ45 moulded Telecommunications outlet plates as SIEMON mounted at 300mm a.f.f.l. All of these shall be cabled to the Floor Distributors.

From a Computer point of view, the wiring shall be **compliant with international standards ISO, IEEE and/or ANSI**. Whichever kind of media is used, it **shall at least be compliant to the future ISO Category 6 up to 200 MHz**

Wall outlets, patch panel outlet and any other type of connectors used will have the same level of quality and performance as the rest of the cabling scheme.

Screened Twisted Pair 0.6mm with individual Pair Foils + Overall Braid Enhanced Category 5 cables shall be provided with **RJ45 (Screened and with shutter) category 5 connectors** (for maximum flexibility in cabling modification).

Distribution of internal telephone lines shall use the same cable as for the Computer connections. It is therefore necessary that the wiring be fully compatible with **international standards (ISO/IEC 11801 and EIA/TIA 568 standards)** and meet the future ISO Category 6 up to 200MHz.

All Floor Distributor cables (data and telephone) and wall outlets shall be **labelled** so as to clearly identify the correspondence between Floor Distributor and wall outlets.

5. BACKBONE CABLE DISTRIBUTION

From the MDF the Telecommunication Sub-Contractor shall supply and install sets of 100 ohm 0.5 Multipair Backbone Media cables drawn in ducts to the Floor Distributor as indicated in the drawings.

6. FLOOR DISTRIBUTOR

The Floor Distributor shall comprise of wall mounted distribution box, housing **SIEMON** type disconnection modules mounted on vertical frames and OF splice trays. The frames shall leave a 50% capacity in reserve for installation of modules in the future.

7. MAIN DISTRIBUTION FRAME (MDF)

All MDF shall be internally labelled with circuit lists as per our drawings in type - written text.

The MDF shall be complete with frames, modules and High voltage protectors and shall be adequately earthed.

The Main Distribution Frame shall comprise of a free standing cabinet with an integrated cable entry, which allows a setting up on false floor.

The cabinet shall accept a combination of splice trays and Twisted Pair **SIEMON** type modules.

The Bills of Quantities gives the equipped capacity only but the MDF shall have a reserve capacity such that the total capacity has four (4) pairs to every Telecommunication outlet.

8. TECHNICAL SPECIFICATIONS

The Telecommunications sub-contractor shall include a **full technical specification and description** of the proposed computer and telephone cabling installations, giving prominence to the minimum requirements.

A complete technical documentation for all components involved shall be furnished.

9. FUNCTIONAL DIAGRAM

The Telecommunication sub-contractor shall submit a **functional diagram** describing the network. The diagram shall clearly identify each component by tag numbers.

10. BILLS OF QUANTITIES

The Bills of Quantities in this document shall be priced. The prices shall be given including all statutory Government tax at the current rate.

11. WARRANTY

The tenderer shall submit **type, duration and conditions of warranty** for the devices installed and the work executed.

12. TESTING

The testing of the functioning of the network and the calibration of the nominal transmission rates shall be clearly specified and defined and their prices included in the quotation. **Report of these tests** shall be given at the final stage.

13. MAINTENANCE CONTRACTS

A **description of maintenance contracts** shall be proposed with detailed description for each service provided as follows:-

- The service(s) offered

- Their limitations

- Responsibility of the client

- Time limits for interventions

- Cost per year

14. EARTHING

All the DPs and other metal parts shall be properly earthed. Electrical and mechanical continuity shall be preserved throughout the whole system from the MDF to the remotest DP and the earth resistance must not exceed 0.5 ohms.

SECTION II:

BILLS OF QUANTITIES

Notes for preparing Bills of Quantities

1.0 Preamble to Bill of Quantities

a) The Bill of Quantities shall form part of the Contract Documents and is to be read in conjunction with the Instructions to Tenderers, Conditions of Contract Parts I and II, Specifications and Drawings.

b) The brief description of the items in the Bill of Quantities is purely for the purpose of identification, and in no way modifies or supersedes the detailed descriptions given in the conditions of Contract and Specifications for the full direction and description of work and materials.

c) The Quantities set forth in the Bill of Quantities are estimated and provisional, representing substantially the work to be carried out, and are given to provide a common basis for tendering and comparing of Tenders. There is no guarantee to the Contractor that he will be required to carry out all the quantities of work indicated under any one particular item or group of items in the Bill of Quantities. The basis of payment shall be the Contractor's rates and the quantities of work actually done in fulfilment of his obligation under the Contract.

d) The prices and rates inserted in the Bills of Quantities will be used for valuing work executed, and the Engineer will measure the whole of the works executed in accordance with this Contract.

e) A price or rate shall be entered in ink against every item in the Bill of Quantities with the exception of items, which already have provisional sums, affixed thereto. The Tenderers are reminded that no "nil" or "included" rates or "lump-sum" discounts will be accepted. The rates for various items should include discounts if any. Tenderers who fail to comply will be disqualified.

f) Provisional sums (including Dayworks) in the Bill of Quantities shall be expended in whole or in part at the discretion of the Engineer in accordance with Sub-clause 52.4 and Clause 58 of part of the Conditions of Contract.

g) The price and rates entered in the Bill of Quantities shall, except insofar as it is otherwise provided under the Contract**, include all Constructional plant to be used, labour, insurance, supervision, compliance, testing, materials, erection, maintenance or works, overheads and profits, taxes and duties together with all general risks, liabilities and obligations set out or implied in the Contract, transport, electricity and telephones, water, use and replenishment of all consumables,** including those required under the Contract by the Engineer and his staff.

h) Errors will be corrected by the Employer for any arithmetic errors in computation or summation as follows:

(i) Where there is a discrepancy between amount in words and figures, the amount in words will govern; and

(ii) Where there is a discrepancy between the unit rate and the total amount derived from the multiplication of the unit price and the quantity, the unit rate as quoted will govern, unless in the opinion of the Employer, there is an obviously gross misplacement of the decimal point in the unit price, in which event the total amount as quoted will govern and the unit rate will be corrected.

(iii) If a Tenderer does not accept the correction of errors as outlined above, his Tender will be rejected.

i) The Bills of Quantities, unless otherwise expressly stated therein, shall be deemed to have been prepared in accordance with the principles of the latest edition of the Civil Engineering Standard Method of Measurement (CESMM).

j) "Authorised" "Directed" or "Approved" shall mean the authority, direction or approval of the Engineer.

k) Unless otherwise stated, all measurements shall be net taken on the finished work carried out in accordance with the details shown on the drawings or instructed, with no allowance for extra cuts or fills, waste or additional thickness necessary to obtain the minimum finished thickness or dimensions required in this Contract. Any work performed in excess or the requirements of the plans and specifications will not be paid for, unless ordered in writing by the Engineer.

l) (a) Hard material, in this Contract, shall be defined as the material which, in the opinion of the Engineer, require blasting, or the use of metal wedges and sledgehammers, or the use of compressed air drilling for their removal, and which cannot be extracted by ripping with a dozer tractor of at least 150 brake horse power (112 kilowatt) with a single, rear-mounted, hydraulic ripper. Boulders of more than $0.2m^3$ occuring in soft material shall be classified as hard material

(b) Soft material shall be all material other than hard material.

2.0 The objectives of the Bills of Quantities are;

(a) to provide sufficient information on the quantities of Works to be performed to enable tenders to be prepared efficiently and accurately;

and

(b) when a Contract has been entered into, to provide a priced Bills of Quantities for use in the periodic valuation of Works executed.

In order to attain these objectives, Works should be itemized in the Bills of Quantities in sufficient detail to distinguish between the different classes of Works, or between Works of the same nature carried out in different locations or in other circumstances which may give rise to different considerations of cost. Consistent with these requirements, the layout and content of the Bills of Quantities should be as simple and brief as possible.

3.0 The Bills of Quantities should be divided generally into the following sections:

(a) Preliminaries.

The preliminaries should indicate the inclusiveness of the unit prices, and should state the methods of measurement which have been adopted in the preparation of the Bills of Quantities and which are to be used for the measurement of any part of the Works.

The number of preliminary items to be priced by the tenderer should be limited to tangible items such as site office and other temporary works, otherwise items such as security for the Works which are primarily part of the Contractor's obligations should be included in the Contractor's rates.

(b) Work Items

(i) The items in the Bills of Quantities should be grouped into sections to distinguish between those parts of the Works which by nature, location, access, timing or any other special characteristics may give rise to different methods of construction or phasing of the Works or considerations of cost. General items common to all parts of the Works may be grouped as a separate section in the Bills of Quantities.

(ii) The brief description of the items in the Bill of Quantities should in no way modify or supersede the detailed descriptions given in the Contract drawings, Conditions of Contract and Specifications.

(iii) Quantities should be computed net from the Drawings, unless directed otherwise in the Contract, and no allowance should be made for bulking, shrinkage or waste. Quantities should be rounded up or down where appropriate.

(iv) The following units of measurement and abbreviations are recommended for use.

Unit	*Abbreviation*	*Unit*	*Abbreviation*
cubic meter	M^3 or cu m	millimeter	mm
hectare	ha	month	mon
hour	h	number	nr
kilogram	kg	square meter	m^2 or sq m
lump sum	sum	square millimeter	mm^2 or sq mm
meter	m	week	wk
metric ton (1,000 kg)	t		

(v) The commencing surface should be identified in the description of each item for Work involving excavation, boring or drilling, for which the commencing surface is not also the original surface. The excavated

surface should be identified in the description of each item for Work involving excavation for which the excavated surface is not also the final surface. The depths of Work should be measured from the commencing surface to the excavated surface, as defined.

(c) Day work Schedule

A Daywork Schedule should be included if the probability of unforeseen work, outside the items included in the Bills of Quantities is relatively high. To facilitate checking by the Employer of the realism of rates quoted by the tenderers, the Daywork Schedule should normally comprise:

(i) a list of the various classes of labour, and materials for which basic Daywork rates or prices are to be inserted by the tenderer, together with a statement of the conditions under which the Contractor will be paid for Work executed on a Daywork basis; and

(ii) a percentage to be entered by the tenderer against each basic Daywork Subtotal amount for labour, materials and plant representing the Contractor's profit, overheads, supervision and other charges.

(d) Provisional Quantities and Provisional Sums

(i) Provision for quantity contingencies in any particular tem or class of Work with a high expectation of quantity overrun should be made by entering specific "Provisional Quantities" or "Provisional Items" in the Bills of Quantities, and *not* by increasing the quantities for that item or class of Work beyond those of the Work normally expected to be required. To the extent not covered above, a general provision for physical contingencies (quantity overruns) should be made by including a "Provisional Sum" in the Summary of the Bills of Quantities. Similarly, a contingency allowance for possible price increases should be provided as a "Provisional Sum" in the Summary of the Bills of Quantities. The inclusion of such provisional sums often facilitates budgetary approval by avoiding the need to request periodic supplementary approvals as the future need arises.

(ii) Provisional Sums to cover specialized works normally carried out by Nominated Sub Contractors should be avoided and instead Bills of Quantities of the specialised Works should be included as a section of the main Bill of Quantities to be priced by the Main Contractor. The Main Contractor should be required to indicate the name (s) of the specialised firms he proposes to engage to carry out the specialized Works as his approved domestic sub-contractors. Only Provisional Sums to cover specialized Works by statutory authorities should be included in the Bills of Quantities.

(iii) Unless otherwise provided in the Contract, the Provisional Sums included in the Bills of Quantities should always be expended in whole or in part at the discretion of the Engineer after full consultation with the Employer.

(e) Summary

The Summary should contain a tabulation of the separate parts of the Bills of Quantities carried forward, with Provisional Sums for Dayworks, physical (quantity) contingencies, and price contingencies (upward price adjustment) where applicable

GENERATOR INSTALLATIONS

SPECIFICATIONS

AND

BILLS OF QUANTITIES

GENERATORS INSTALLATION
GENERAL SPECIFICATION
PART B

1.0 General

This section specifies the general requirements for the generators installation and shall apply except where otherwise specified. The Sub-Contract Works shall comply with the General Specification where read in conjunction with the particular specification and any other requirements of the Specification as previously defined.

1.1 Regulations and standards

The Sub-Contract Works shall comply with the current I.E.E Regulations, and the By-laws of the Electricity supply Authority. The Sub-Contract Works where relevant shall comply with the following:-

i) British standards) Current Edition as published by the British
) Standards.

ii) British standards) Institution and the Council for codes of
) practice.

1.2 Quality of Materials and Manufacturing Standards

Materials and apparatus required for the complete installation as called for in the particular Specification or sub-contract Drawings, shall be supplied by the Sub-Contract unless mention is made otherwise.

Unless otherwise specified all materials shall be in new conditions and manufactured to appropriate standards of the British Standards Institution, the I.E.E Regulations or other equivalent and approved standards.

Defective equipment or that damaged in course of installation or test, shall be replaced or repaired to the approval of the Engineer.

Materials and equipment supplied by the Sub-Contractor shall be as specified and no variations will be permitted without written consent of the Engineer.

Should any replacement be necessary, the Sub-Contractor shall bear the cost of any associated Buildings work and making good finishes.

1.3 Labelling

All plant, apparatus, equipment, valves, control panel, selector switches, isolating equipment, terminals and cable cores shall be securely and properly labelled by the Sub-Contractor to the

approval of the Engineer. The labelling shall be such to show clearly the identification of the item and if applicable its control function and the part of the system controlled.

1.4 Scope of Works

The Sub-Contractor shall supply, deliver, install and commission complete diesel generators installation and ancillary equipment as shown on the Sub-contract Drawings and detailed in the specification. The Sub-Contractor shall be responsible for all wiring from the generators control panel to the switchgear and other ancillary equipment thereon, including provision of all control wiring for the generators installation.

The Sub-Contractor shall provide free maintenance during the guarantee period and undertake to enter into a servicing agreement with the Employer if so requested at current local market rates of payment for such agreement.

1.5 Work by Others

Construction of the Generators Room and the foundation for mounting the engines shall be carried out by others to the requirements of the Sub-contractor. The Sub-Contractor shall however be responsible for the accuracy of information regarding his requirements as declared at the time of tendering. Any subsequent changes in requirements asked for by the Sub-Contractor shall be at the expense of the Sub-Contractor.

1.6 Compliance

The Tenderer shall give a statement of compliance with this specification as part of his tender and shall be bound to that statement of compliance in all respects at all times during the execution of the works as detailed in this specification.

1.7 Employer's Staff

The Sub-Contractor shall, if requested, arrange for the training of staff nominated by the Employer at the sub-Contract's office at site or at the works of the manufacturerssupplying the plant for the installation. The cost of providing adequate training within six months shall be quoted.

1.8 Patent Rights

The Sub-Contractor shall fully indemnify the purchaser and all others concerned against any action, claim or proceedings relating to the infringement of any patent or design or any alleged patent or design rights and shall pay any royalties which may be payable in respect of any design thereof shall have been supplied by the Contractor to thePurchaser.

1.9 Liaison

The Sub-Contractor shall liaise fully with the Main Contractor as mentioned in Clause 1.5.

PART C

PARTICULAR SPECIFICATION AND CONDITIONS

INDEX

PART C

SECTION ONE

PARTICULAR SPECIFICATION AND CONDITIONS

1.00 PARTICULAR CONDITIONS

1.01 Location of Site

The site of the proposed works is in Machakos

The following climatic conditions apply at the site of the works and all plant, equipment, apparatus, materials and installations shall be suitable for these conditions: -

Maximum temperature	27.1^0 C	}
Minimum Temperature	14.0^0C	}
Relative humidity range	55 - 75%	} Conditions
Altitude	1616 metres above sea level	} for Machakos

1.02 Description of Project

The project comprises the development of boundary wall and ancillary buildings

1.03 Scope of Sub-Contract Works

The work covered by this specification includes the supply, delivery, installation, setting to work, commissioning to the satisfaction of the Engineer, and maintenance for a period of twelve months, of 1 No. 30 kVA Diesel Engine Generating Set and at 3 x 415/240 volts 50 Hz, complete with acoustic canopy and all necessary ancilliary equipment as indicated complete with all accessories

The Contractor shall allow for connecting the generators to the main switchboard through an Automatic standalone load sensing and sequencing panel as specified, including all accessories.

As specified herein, the set shall be used for Automatic standby operation. It shall also be possible to start, operate and stop the generators set manually independent of any automatic features.

Within the operating conditions specified, the generators set shall be capable of starting and accepting full load within the shortest possible time and in any case in not more than 10 seconds.

Within the operating conditions specified, the set with its standard air intake filters, should be capable of delivering its rated output continuously at rated voltage and 0.8 lagging power factor, and of delivering 10% in excess of the continuous maximum rating for a period of one hour in any 12 hour period.

The steady state voltage should be maintained within $2^1/2\%$ of rated voltage under control of the voltage regulator, between cold start ambient conditions and maximum working temperatures, at any load from no load to 10% overload and from unity to 0.8 lagging power factor. After any change in load, the voltage shall not vary by more than $\pm$15% of the rated voltage and shall return to within $\pm$3% within 3 seconds and to within $2^1/2\%$ of rated voltage within 15 seconds. On starting, the voltage overshoot shall not exceed 15% and shall return to within 3% in not more than 3 seconds.

1.04 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.

1.05 Duration of Contract

The Sub-Contractor shall be required to phase his work in accordance with the Main Contractor's programme (or its revisions). The programme is to be agreed with the Main Contractor. However the generators sets should be delivered and installed not later than 130 weeks from the date of award.

1.06 Contract Drawings

The Sub-Contractor shall be deemed to have studied all the relevant Contract Drawings listed or referred to in and forming part of the specification.

SECTION 2

DIESEL ENGINE

2.0 Cylinder Block

The cylinder block shall be made of one-piece cast iron. It shall have full length water jacket with circulation around each cylinder. The cylinder block shall have wet liners with rubber seal at the bottom end.

2.1 Cylinder Head

The cylinder head for each bank of cylinders shall be of one piece and manufactured from cast iron. It shall be secured by studs of high tensile steel and be easily detachable. Valve seats shall be replaceable.

2.2 Pistons

The pistons shall be made of die cast aluminium alloy and tapered with a ground skirt. The pistons shall have atleast three compression and two oil control rings. The combustion chamber and the valve recess shall be smooth contoured. The pistons shall have fully floating pins.

2.3 Valves

The valves shall have separate guides presses into the cylinder head. Operating shall be of the normal pushrod/rocket type with tappet adjustment at the rockerarm.

2.4 Fly-Wheel

The Fly-Wheel shall be of heavy cast iron with close coupling type cast iron flywheel housing and shall have a gear ring bolted onto it. the gear ring shall have heat treated teeth.

2.5 Cranksheet

The cranksheet shall be forged steel with induction hardened main and journals. It shall statically and dynamically balance and shall have replaceable, line steel shell bearings.

2.6 Connecting Rods

The connecting rods shall be of `1' Section forged steel.

2.7 Fuel and Air System

The engine shall have a mon-block injection pump which is gear driven through flexible coupling. The fuel pump shall be integral and shall incorporate a hand primer. The engine shall have a multi-core injector nozzle. A fuel filter shall be provided complete with a replaceable element and the engine shall have a heavy duty oil bath air cleaner.

2.8 Governor

The Governor shall be of the centrifugal type operating direct on the fuel line and shall be capable of maintaining the speed constant within 33/34 of nominal output in accordance

with B.S.489:1958 Class A2.

2.9 Protection

The engine shall be provided with the following protective devices capable of providing audible and visible alarm signals at one or more remote locations.

a) Low lubricating oil pressure
b) High lubricating oil temperature
c) High cooling water temperature
d) High engine speed

2.10 Instrumentation

The engine shall be provided with the following instruments to indicate various speeds and temperatures:-

i) Tachometer indicating the engine speed.

ii) Instrumentation to indicate the temperature of the exhaust gases.

iii) Instrumentation to indicate the temperature of the lubrication oil.

iv) Instrumentation to indicate the pressure of the lubrication oil.

v) Instrumentation to indicate the pressure of the cooling water.

2.11 Ancillary Equipment

The Sub-Contractor shall be responsible for providing the following ancillary equipment required for the installation:

a) Exhaust piping and heavy duty silencer including lagged flexible piping off the engine exhaust manifold. The exhaust piping provided shall be sufficiently long to cover the route shown on the Contract Drawings. The Sub-Contractor shall liaise with the Main Contractor for the final positioning of the exhaust pipe. The duct should be extended to discharge exhaust fumes at roof level.

b) Semi-rotary hand pump to be mounted adjacent to the header tank with necessary piping from pump to header tank.

2.12 Cooling System

Unless otherwise specified elsewhere, a suitable radiator shall be provided for the cooling water and lubricating coil requirements of the engine when operating under the site conditions stated. This shall be complete with engine driven fan and drive, guard for fan and drive, belt tensioner and all integral oil and water piping connections.

A suitable duct from the radiator face flange, extending to the engine roomwall, total distance one metre, shall be supplied incorporating a flexible section if required.

Circulation of both lubricating oil and primary water shall be catered for by means of geared or belt driven pumps, integral with engine.

A thermostatic by-pass shall be fitted in the water outlet from the engine to give a quick warm up and even temperature control over the load range.

2.13 Lubrication

The engine components shall be lubricated via a pressure oil system from an integral oil pump driven by the engine. The system shall incorporate oil filter, the secondary oil filter being of the changeable type. A suitable relief valve shall be provided to maintain the pump discharge pressure within safe limits.

2.14 Starting

The engine shall start put by means of a D.C. motor which shall be supplied from a set of rechargeable batteries of an appropriate voltage and of such a capacity as to enable up to ten start-ups in one hour when fully charged.

2.15 Compliance

The equipment and installation shall comply with B.S. 649 and also with C.P. 323.

The Sub-Contractor shall in his statement of compliance confirm that the engine would be capable of running on class `A' fuel to B.S. 2869:1957.

2.16 Noise Level

The Sub-Contractor shall state in his statement of compliance the level of noise in decibel expected in the engine room.

2.17 Ancillary Power Requirements

In selecting the size of the diesel engine, the Sub-Contractor shall make suitable allowances for power requirements for the cooling system, the lubricating system and any other requirements that may be necessary for that set.

2.18 Ventilation

The Sub-Contractor must ensure that adequate ventilation in the generators room is provided.

SECTION 3
GENERATORS SET

3.0 Alternator

The alternator shall be of 12 wire reconnectable brushless type rated at 0.8. p.f. lagging in accordance with B.S. 2612:1975 and having a revolving field, a single self aligning roller bearing and solid half coupling to connect to the engine.

The alternator shall be screen protected, drip-proof and shall be wound with high temperature, tropicalised class B insulation of the stator and class F insulation on the rotor. The stator frame shall be barrel design with conventional two layer winding in semi-enclosed skewed slot, pitched to give a good wave-dorm with low harmonic content.

The rotor core shall be specially constructed with strip winding to obtain maximum cooling the rotor and stator.

3.1 A.C. EXCITER

An A.C. exciter of direct-coupled flange mounted type shall be supplied. The exciter frame shall be of modular iron and shall serve additionally as the bearing housing. The exciter armature shall be mounted on a tub on the alternator shaft. Connections shall be taken to the rotating rectifiers, which shall be carried on aluminium castings, from the main room.

3.2 Automatic Voltage Regulator

A Thyristor type static automatic voltage regulator shall be built into the machine. This regulator shall incorporate a zener diode bridge reference voltage circuit, thyristor drive reactor with series silicon diode and a further commutating diode. Under steady conditions, the automatic voltage regulator shall maintain the voltage within plus or minus 2 1/2% for all balanced loads between unity and zero lagging. The automatic voltage regulator shall be complete with hand-operated manual control potentiometer which shall be fitted in control pane.

The voltage level controls shall enable the terminal voltage to be adjustable within the range - 5% to +10%.

The Voltage drop controls shall be adjustable for proper division in reactive KVA when operating in parallel with other alternators.

The voltage gain controls shall be adjustable to compensate for engine speed variations when operating with a speed-droop governor. After any change of load, the voltage shall not vary by more than plus or minus 15% the rated voltage, and shall return to within plus or minus 3% within 3 seconds, and to within plus or minus 2.5 of rated voltage within 15 seconds. On starting, the voltage overshoot shall not exceed 15% and shall return to within plus or minus 3% within 3 seconds.

3.3 Terminal Box

Any suitable dimensioned terminal box suitable for conduit or cable entry shall be supplied with undrilled gland plate.

3.4 Rating

The machine shall be continuously maximum rated in accordance with B.S 2613 and shall be so derated owing to site conditions - at the specified electrical output is obtained for the alternator. The Sub-Contractor shall provide additional labelling on the generators to distinguish clearly between the nameplate ratings and the actual ratings on site.

The tenderer's manufacturer's catalogue should indicate the percentage reductions from the nameplate rating resulting from altitude and inlet temperature for any of the following engine variations: -

a) Naturally aspirated

b) Turbo-charged without a charge air cooler

c) Turbo-charged with a charge air cooler.

3.5 Radio Interference Suppression

The generators sets shall be suppressed for radio interference in accordance with B.S. 833 and C.P 1006.

3.6 Duty Performance

The generators will be used as a standby generators.

3.7 Generators Set Specification

The generators shall be rated for the following parameters after suitable derating for the site service conditions and allowing for power requirements for integral cooling system, lubricating system and any other integral parts of the set.

Generators output	1 No. 30 kVA Prime Rated
Power factor	0.8 lagging
No load voltage	415 volts
Phases	3
Frequency	50 Hz
Speed	1500 r.p.m
Ambient Temp.	up to 45^0 C.

3.8 Testing and Commissioning

The Sub-Contractor shall include for fully commissioning the set and its control equipment, and for the purpose of the required tests, shall provide all necessary instruments, tools, fuel and lubricating oil.

The tests and checks shall be carried out by the Sub-Contractor in the presence of the Engineer or his representative, as applicable.

i) Check that the main frame is level in all directions, engine and generators shafts are in proper alignment and the vibration absorbing devices are properly installed and located.

ii) Check water and sump oil levels and that the water jacket is in working order.

iii) Check the battery electrolyte levels and the specified gravity.

iv) Ensure that sufficient oil is in the fuel tank for a two hour test run.

v) Examine the containers in which the fuel and lubricating oils were delivered and check that the type of oils is recommended for the unit.

vi) Check that the engine block water drain points are free from sludge and other blockages.

vii) Check engine bolts, main drive coupling, valve clearance, fuel pumps section, governor settings, pipe line connections, water hose, exhaust couplings, flexible pipe-work etc. and the ball valve and overflowwork.

viii) Check all out-going connections on the generators and at the control panel. All lugs for principal connections shall have clean and bright contact surfaces. A suitable abrasive material shall be used where necessary.

ix) Check access panels and doors for proper opening and closing and for the functioning of any interlocks fitted.

x) With the set isolated from the main supply and the selector switch in the `Manual' position, start the engine by means of the `start' push button and allow it to run upto normal speed.

Check that during the time the engine starter motor is in operation, the main battery charger is automatically switched off to avoid its being overloaded by the reduction in voltage across the battery.

xi) Check instruments and gauges for normal operation and response and that the generators voltage is being maintained within the prescribed limits, making due allowance for no-load conditions. Compare the reading of the frequency meter with that of the engine tachometer.

xii) Stop engine by turning selector switch to "off" position and verify that generators contactor opens as between 95% and 85% normal voltage. Re-check water and oil levels.

xiii) Turn selector switch to `Auto' position. Disconnect the sensing circuit supply and check that the set starts, the mains contactor opens, and the generators contactor closes in correct order. Reconnect the sensing circuit to verify that the engine stops on restoration of the mains supply and the contactors operate correctly. Check voltage sensing time delays on each phase in turn and also that the push buttons for mains failure simulation and engine stopping operate correctly.

NB Running of the engine for any length of time under-no-load conditions is undesirable and tests calling for such operation should be carried out in as short a time as is consistent with thoroughness.

xiv) Operate the necessary isolators and switches to put the set on stand-by for essential services network with the selector switch in the `Auto' position, and using the mains failure simulation push, verify that the set operates correctly with the appropriate time delay for taking up load and that the carrying of the load and its distribution over the three phases are satisfactory.

xv) Run the set at various loads for periods totalling at least 30 minutes. Check the voltage and current in each phase in turn and that the voltage and frequency are being maintained within the required limits with large alterations of load.

xvi) Check the operation of the turbo-charger units and the colour of the exhaust gas at various loads.

xvii) Check that the various engine safeguards operate satisfactorily.

(xviii) Check the vibration absorbing devices for proper operation and that the performance of all flexible connections, both mechanical and electrical, is satisfactory.

xix) Re-check the lubricating oil and water level, replenish the fuel oil tank and leave the set in normal operating order.

xx) An initial supply of all lubricating oils and greases shall be provided by the Sub-Contractor.

SECTION 4

CONTROL CUBICLE

4.0 General

The control panels shall be totally enclosed type plant mounted on anti-vibration mountings on the alternators, fitted with removable covers giving access to the control gear, terminal and connection blocks and undrilled gland plates for cables entry and shall be finished in stove enamelled grey hammer paint. The control panel shall be appropriately rated.

4.1 Function

The control cubicle shall house the start/stop buttons and protection systems and shall be complete with all the necessary relays and circuitry.

4.2 Control and Logic Section

Facilities shall be available with suitable circuit breakers protection for the following functions:-

a) Manual start
b) Manual stop
c) Stall lock-out, ie a lock-out to prevent recranking of an engine upon fuel failure, or stall conditions.

4.3 Protection Circuits

Suitably fused protection circuits, for oil, water, speed and one spare, shall be allowed for. The first stable protection shall be by means of fail-safe circuits while the second stage shall be energised on halt circuits. all circuits except overspend shall be commissioned after a delay following engine start-up.

The circuits for:-

a) Lubricating oil pressure
b) Water temperature
c) Spare

shall be either alarm, or alarm and shut-down. The latter shall be achieved by means of a link within the control panel.

The circuit for engine overspend shall give simultaneous alarm and shut down. When the engine has a faulty condition, the protection circuits shall still accept further faults. Once a shut-down signal has been given, the protection circuits shall be locked on as:

i) not to give further fault indication as engine stops.

ii) to give indication of fault condition even when the engine has stopped.

The fault circuit shall be re-set by pushing the "Re-Set" button.

One audible alarm mute shall be provided for each fault channel. This shall mute the alarm for the fault causing the alarm, but shall leave the Klaxon prepared for further faults.

4.4 Switching Section

A suitably fused switching section for engine functions as per list below shall be provided:

a) Fuel rack solenoid (start or stop)

b) Starter motor solenoid vial a repeater.

4.5 Indication

Indicator lamps as per list below shall be provided:

a) Engine running and protection circuits commissioned - green.

b) Fault parameters - all red.

The indication circuits shall have a lamp test push button by means of which the lamp filaments can be tested.

4.6 Control Switching

A rotary switch with off/on positions, to switch the control circuit supplies. In the `ON' position the engine shall be started by depressing a push button and stopped by depressing a `stop' push button.

The indicators, switches and push buttons shall be mounted on the front face of the chassis unit.

4.7 Alarm

The Sub-contractor shall supply and install a Klaxon which is loud enough to be heard even when the engine is running. The supply for this Klaxon shall be obtained from the control cubicle through rated fuses.

4.8 Mains Detection

A mains detection unit which can register a mains voltage failure under the following conditions shall be provided:-

a) Failure of any one or more phases
b) Incorrect phase sequence
c) Low volts on any individual or all phases - i.e below 85% of normal voltage.
d) Excessive frequency change i.e minus or plus 3 Hz.

The failure condition shall be used to produce a start signal for the standby engine after a delay. The delay shall be adjustable and shall ensure the failure is not a transient condition.

Mains detection condition shall be used to produce a start signal for the standby engine after a delay. The delay shall be adjustable and shall ensure the failure is not a transient condition.

Mains detection units shall receive their sensing supplied from the busbars feeding the

load.

4.9 The following equipment shall be provided by the Generators supplier:-

a) Moulded case air circuit breaker, triple pole and neutral, with magnetic release to provide alternator short circuit protection, trip free handle and shunt trip.

b) One bolted neutral link.

c) Alternator voltage trimmer regulator

d) 3 No. one per phase, flush mounting ammeters.

e) 1 No. one flush mounting ammeters.

f) 1 No. one voltameter rotary selector switch

g) One set of control circuit instruments and the accompanying fuses.

h) All internal wiring, terminals, cable lugs, legends and one main earthing bar.

i) One No. frequency meter, vibrating leaf type

j) One No., governor motor raise and lower switch.

k) Cable boxes and glands to suit.

l) One No. Kilowatt-hour meter

4.10 Terminations

All internal wiring terminations shall be numbered and marked with ferrules.

4.11 Earthing

The Sub-Contractor shall be responsible for ensuring that the earthing of the generators neutral is carried out efficiently and that the resistance of the generators neutral from the earth does not exceed one ohm.

The Sub-Contractor shall be responsible for the installation of a set of earth electrodes, the electrodes shall comprise four earth rods, installed in pairs, each pair connected together and to the earth bus-bar by an insulated stranded conductor. The earth rods shall be 2m long by 15m diameter, extensible type as "copperweld" or other equal and approved, each pair of electrodes shall be located not less than 3m apart, the first pair being not less than 3m from the building.

The head of the earth rods shall be driven to 300mm below the surface of the ground and enclosed in a concrete box with a concrete inspection cover.

The Sub-Contractor shall ensure that the earthing system of the generators is adequately bonded to the permanent earth system of the `normal' supply.

All earthing shall be carried out in accordance with the appropriate section of the I.E.E Regulations.

4.12 Trickle Charger

The trickle charger shall have rating and service parameters such as to keep the engine start batteries fully charged and ready for service whenever required. When the engine is running the batteries shall be charged from an integral dynamo.

4.13 Hours Counter

The Sub-Contractor shall allow for the installation of an hours counter on the control panel of the generators.

4.14 Automatic Changeover Contact Unit

A contactor unit shall be provided which on failure of the normal electricity supply will automatically initiate the starting of and effect the transfer of load to the stand-by generators. The unit shall contain power contactors and ancillary apparatus as specified.

b) Failure of the normal supply shall mean complete loss of voltage or the falling below 85% of the normal voltage between any two phases or phase andneutral.

c) The power circuit shall consist of two contactors feeding a common busbar to which the load will be directly connected. One contactor shall control the electrically and mechanically interlocked so that they cannot both be closed at the sametime.

d) On failure of the normal supply, the unit shall operate in the followingmanner:-

i) After a delay, adjustable from 0 to 5 seconds (to avoid operation by a transient dip in voltage) a signal shall be given to start the stand-by generatingset.

ii) On receipt of a signal from the stand-by generating set that it is ready to take the load and providing that the failure of the normal supply still persists, the normal supply contactor shall close. If the normal supply has been restored before the change-over has taken place, the contactors shall not operate and the starting delay contacts shall open to initiate the shutting down of the stand-by generating set.

e) When the stand-by supply is in operation and the normal supply is restored and remains within 10% of the rated voltage on all phases for a pre-set time (adjustable to 30 seconds) the stand-by contactor shall open and the normal supply contactors shall close; the starting relay contacts shall then open to shut down the stand-by generating set.

f) Provision should be so made that automatic return to normal supply can be prevented if required.

g) Once a start signal has been sent to the stand-by generating set, the engine starting sequence shall be allowed to continue until the set is ready to take the load before a stopping signal is sent.

h) By addition of external connections the following facilities shall be available:-

i) Remote starting of the stand-by generating set and transfer of the load to it.

ii) Restoration of the normal supply on failure of the stand-by generatingset.

i) Each switch shall be labelled with its duty and each position shall be marked.

The following shall be fitted:-

i) Contactor Hand Control switch, with make before break contacts and `Hand' position the unit shall be controlled by the "Contactor Hand Control Switch". In the `auto' position the unit shall operate automatically irrespective of the position of the

"Contactor Hand Control Switch". In the `auto position the unit shall operate automatically irrespective of the position of the "Contactor Hand Control Switch".

ii) A contactor Hand Control Switch; with `Stand-by" and `Normal' position.

iii) An Auto Return Switch, having `on' and `off' positions. In the `on' position the return to normal supply shall be automatic when the normal supply is restored.

iv) Contactor By-pass switches; shall be provided to enable the essential load circuits to be served direct from the normal supply to enable the generators and/or the control equipment to be serviced. The by-pass switches shall be provided with a suitable and conspicuous label warning against leaving the generators in the disconnected position.

j) Indicating lamps shall be provided. They shall be appropriately labelled easily visible and shall give the following information.

i) Normal supply available
ii) Stand-by supply available
iii) Normal supply in use
iv) Stand-by supply in use

k) A push button labelled `Test' shall be provided to enable a failure of normal supply to be simulated. If the button is pressed and released the equipment shall complete the starting sequence and when the set is ready to take the load it shall be shut down. If the button is held depressed the equipment shall change-over to the stand-by supply when the set is ready to take load.

l) The control circuit supply shall be either 12 volts or 24 volts d.c depending upon the starting battery and charger.

No current shall be drawn from the control supply when the unit is accepting the normal power supply.

4.14 BMS COMPATIBILITY

The supplier/Sub contractor to ensure BMS compatibility of all supplied generators, pumps, fuel tank gauges and all other equipment

SCHEDULE NO. 1

SUMMARY OF INFORMATION FOR TENDERS

The Tenderer is advised to read the relevant section of the Specification for full details of the items summarised below:

Item	Requirements	Ref. Clause
1. Operating conditions	Nairobi	1.1
Site	**in Kisumu**	
Altitude	1131 metres above sea level	
Relative humidity range	40 - 80%	
To operate in	unheated building	
Dust conditions	Dust laden atmosphere	
2. Duty	Mains failure unit and duty power	3.7
	10 starts per hour	2.14
3. Performance	1 No.30kVA Prime Rated Generator , 415 Volts 3 phase, 50 Hz,	3.7
4. Set Arrangements Weather proof roof and side panels	required	
5. Remote governor control	required	
6. Aspiration	natural	
7. Manual start	required	
8. Sump heater	not required	
9. Silencer: - details of additional pipework and fittings is required		2.11a
10. Daily service tank: capacity if other than 24 hours	...litres/.....hours	2.11b
Transfer pump	hand pump	2.11d
Auxiliary fuel tank: sitting	required	
capacity	.....	

11. Fuel jettison cock for		
a) Daily service tank		
b) Auxiliary fuel tank	required	
12. Engine instruments:		
Details if not as standard		2.10
13. Cooling system	required	2.12
14. Electrical control panel:		
Main Switch	Circuit breaker	4.9
Provision for parallel running	not required	
15. Lock-out remote indication circuit	required	4.2
16. Fire service terminals	required	
17. Earth fields	required	
18. Building drawing	required	
19. Maintenance period	12 months	
20. Sound Proof Canopy	required	

SCHEDULE NO. 2

A. TECHNICAL DETAILS OF THE 1 No. 30 kVA Prime Rated Generator SET OFFERED BY TENDERER

	Item	Details
1.	Diesel Engine	
	Make	_____
	Type	_____
	Bore	_____mm
	Stroke	_____mm
	Net continuous rating (B.S. 649) (a) At sea level	_____kVA
	(b) At site	_____kVA
	speed	_____rev/min
	Year this type put into service	_____
	Total number sold	_____
	a) Worldwide	_____
	b) In East Africa	_____
	c) In Kenya	_____
	Aspiration:	_____
	Make	_____
	Type	_____
	Number in use	_____
	Thermometers:	_____
	Make	_____
	Type	_____
	Air cooling:	_____
	Quantity of air required	_____m^3/sec
	Details of ducting 1 No. 30 kVA Prime Rated Generator	_____

Water cooling _____

details of water cooling circuits _____

Radiator:- _____

Make _____

Type _____

Length _____mm

Breadth _____mm

Height _____mm

Aspiration: _____mm

Method _____

Quantity of air required _____m^3/s

Item	Details		
2. Auxiliaries	Make	Type	Other Relevant
Lubricants Oil Circuits			
Filter			
Coolers			
Primary pumps			
Tachometer and drive Governor			
Cold start devices			
Running hours meter			
Safety devices:			
High temperature			
Low pressure (Lubricating Oil)			
Cooling water flow trip			
Overspeed trip			
Speed sensing devices			
Lubricating oil thermometers: number position(s) Water thermometer:-			
Starting Battery			
Sound Proof Canopy			
Immersion heater			

3. Lubrication

Recommended oil (s)
Sump

Elsewhere (state where)

4. Alternator and exciter 1 No. 30 kVA Prime Rated Generator

Make and type

Bearings * ball/roller/plain
Insulation class (BS. 27 7

---

* delete as necessary

Item	Details
	1 No. 30 kVA Prime Rated Generator
	Make type Rating

4. Electrical Control Panel

Location of Control panel: _____

Confirm the following minimum instrumentation fitted:

Alternator output ammeter: _____

Alternator output voltmeter: _____

Alternator output frequency meter _____

Alternator output Kilowatt meter _____

Generators service hours records _____

Confirm the following minimum controls fitted:

Ammeter selector switch: _____

Voltmeter Selector switch: _____

Engine control manual/ auto selector: _____

Generators test facility: _____

Confirm the following sequence relays/timers are fitted:

Phase failure detection circuit and one or all three phase adjustable: _____

_____ _____

_____ _____

Multi-attempt start: _____

_____

_____

Mains return stop delay adjustable: _____

Engine cool-down off-load delay: _____

Confirm the following minimum protection circuits with automatic shut down and alarm indication are provided:

Engine failure to start: _____

Engine low oil pressure: _____

Engine high temperature _____

Engine overspeed _____

Type of indication provided (CCD or filament lamp): _____

Lamp test push button: _____

Details of Engine Starter

Battery static charger: _____

Alternator output circuit breaker:

Make: _____

Rating in amperes: _____

Number of poles: _____

Details of protection system: _____

Mains/Alternator change over:

Contactors:

Make: _____

Rating in amperes: _____

Number of poles: _____

Electrical Interlock: _____

Mechanical Interlock: _____

By-pass switch

Make: _____

Rating in amperes: _____

Number of poles: _____

Indicator lamps - No. .....* _____

Ammeter switch _____

Voltmeter switch _____

kWh meter _____

Frequency meter _____

Ammeter - No. .....* _____

Voltmeters No. .....* _____

Power factor meter _____

Other equipment - give details _____

6. <u>Performance data</u>

Fuel Consumption	Rounded output	Output
	%	Kg.Wh
	110	
	100	
	75	60 1/hr
	50	

Maximum output at site	Ambient Temp^{0}C	output kVA
	40	
	30	
	20	
	10	

- rev/min _____

Cyclic irregularity _____

Voltage regulation _____

Frequency regulation _____

Time to accept 75% full load from 5 degrees C. _____

7. Physical Details

Daily service tank for 24 hour operation capacity _____

Size

Total weight of set _____

Overall dimensions of set _____

Weight of heaviest component _____

Weather proofing _____

8. Operational Details

Description of operation sequence of the automatic control (where fitted)

Details of drawings, literature, e.t.c., included with tender

9. Delivery Details

Time in weeks from acceptance of tender to delivery of all equipment to site _____

Time in weeks from acceptance of tender to commissioning tests _____

SCHEDULE NO. 3
DEVIATIONS FROM THE SPECIFICATION

The tenderer shall give below details of any equipment, which does not meet the specification, or any other deviations, omissions, additions or alternatives in respect of the set which he is offering.

Indicate the same below,else it will be considered that all equipment proposed by the bidder in this tender document meet the specifications as indicated in this tender document with no variations/deviations whatsover

LIST OF SPARE PARTS AND LUBRICANTS TO BE SUPPLIED WITH EACH SET

The following items shall be handed over to the Engineer before completion of this contract. They shall not be used by the contractor contrary to carry out his normal maintenance.This also applies per generator set

Item	Details	Price (Kshs)
1	Oil filters - 3 No.	
2	Air filters - 3 No.	
3	One injector to suit the set	
4	One set of fan belts comprising ..... belts	
5	One set of indicator bulbs comprising.....bulbs	
6	One overhaul kit	
7	One set of fuses comprising ..... fuses	
8	One 60 litre plastic container of sump of oil grade.....	
9	One 2 kilogram tin of grease grade	
10	One 10 litre plastic container of distilled water.....	
	Total carried forward to price summary schedule	

The tenderer shall give below details of any other spares which he recommends to be purchased as an optional extra.

Details Price

Signed (as in tender) .....

Date: .....

SCHEDULE NO. 5

EARTHING

The tenderer shall insert his prices for the following items. The configuration of the earth fields shall be as directed by the Engineer on site. This also applies per generator set

item	Details	Price (Kshs)
1	Supply and install 2 No. steel cored copper earth rods, 1200mm x 12mm threaded for extension, connected by brass clamps to 10 metres of 25mm x 3mm copper earth tape laid in trenches of minimum depth 300mm and fixed to the wall of the generators room with brass spacer bar saddles at 1 metre intervals, connected to the station earth bar via a brass test clamp	

Price per additional earth .....

Price per additional meter of earth tape .....

Signed (as in tender).....

Date: .....

SCHEDULE NO. 6

PRICE SUMMARY

Item	Details	Kshs
1	Sub-Contract Preliminaries	
2	Supply, Installation, Testing and commissioning of 1 No. 30 kVA Perkins UK (**GENERATOR SHOULD BE OF EUROPEAN ORIGIN**) Prime Rated Generator sets complete with super silent acoustic and weatherproof canopies with a maximum noise level of 67dB at 7 metres on full load, automatic mains failure panel, Automatic change over switch, power supply and control cables complete with all accessories, metres lagged exhaust pipe extension and silencer for each set , and all other necessary accessories for each set (& Provisional distance from	
3	generators to main LT switch board is 30 metres subject to physical confirmation by the generator supplier/installer on site)	
4	Supply of "AS FITTED" drawing and maintenance manuals	
	Schedule 4 - supply of spares and lubricants	
5	Schedule 5 – Earthing	
6	Allow contingency sum to be used at the	
7	discretion of the Architect/Client	350,000.00
	TOTAL, VAT INCLUSIVE (WHERE APPLICABLE) CARRIED FORWARD TO THE GRAND SUMAMRY PAGE FOR ELECTRICAL INSTALLATIONS	

Amount in Figures: Kshs: .....

Amount in Words: Kenya Shillings: .....

.....

.

Duration of Contract..... Weeks

Official Stamp: .....

.....

.....

Tenderer's Signature: .....Date: .....

Witness Name: .....Witness Signature: .....

Address: .....

.....

Date:.....

BILLS OF QUANTITIES

FOR

GENERAL ELECTRICAL INSTALLATIONS,

STRUCTURED CABLING INSTALLATIONS

&

CCTV INTALLATIONS

SCHEDULE OF PRICES

GENERAL NOTE

1. The total of price in the summary of prices shall include for the whole of the Sub- Contract Works in accordance with the specification as defined before and shall be carried forward to the Form of Tender.

2. Any prices omitted from any item, section or part of the price schedule shall be deemed to have been included in another item, section or part.

3. The prices shall include for all obligations under the Sub-Contract including and not limited to:-

   a) Supply of all materials, equipment, apparatus, fittings, spares and tools

   b) Insurance

   c) Clearing and forwarding

   d) Delivery and storage at site

   e) Packing for storage

   f) Replace any defective or damaged item

   g) Installation

   h) Testing

   i) Painting

   j) Commissioning

   k) Maintenance during the defects liability period

4. The unit rates shall include import duty, sales tax, and VAT where applicable, and shall be expressed in Kenya Shillings.

[redacted]

GENERAL ELECTRICAL INSTALLATIONS

[redacted]

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR ELECTRICAL INSTALLATIONS

ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
				KES	KES
1.1.00	**LIGHTING POINTS AND FITTINGS**				
	Supply, install, test, commission and maintain:-				
1.1.01	Lighting points wired in 1.5sqmm PVC insulated single core (SC) copper wires drawn in 20 mm HG PVC conduits concealed in walls and floors,one way switched with all accessoriesbut excluding switch and fitting. Cables as East African Cables	No.	24		
1.1.02	Ditto, for two way lighting points	No.	100		
1.1.03	10A wide rocker plateswitch 1 gang two-way SP as MK K4781WHI	No.	22		
1.1.04	10A wide rocker plateswitch 2 gang two-way SP as MK K4782WHI	No.	12		
1.1.05	10A wide rocker plateswitch 3 gang two-way SP as MK K4782WHI	No.	8		
1.1.06	10A wide rocker plateswitch 1 gang Intermediate switch MK K4785	No.	2		
1.1.07	1200mm 25W LED twin corrosion resistant luminare as Philips Coreline Waterproof 911401535291complete with Led lamps Type "F7"	No.	4		
1.1.09	Maintained emergency exit luminare illuminated by L.E.D.s with 3hr NiCd battery backup with extruded aluminium support rail enclosing l.e.d's on linear PCB, supported by chains, suspended from ABS injection moulded housing, enclosing battery and electronic control circuits,Type "ET"	No.	3		
1.1.10	Decorative Weather Proof Wall Lamp 12W LX Black Outdoor Bulkhead JSL Lights 609 Type "S1"	No.	22		
1.1.11	Decorative Weather Proof Wall Lamp 12W LX Black Outdoor Bulkhead JSL Lights 509 Type "S"	No.	14		
1.1.12	600 x 600mm x 60 mm LED Panel Light, 38 W as Phillips CoreLine Panel gen6 brand, 4000K, 5000lm or approved equivalent complete with LED lamps and all other accessories Type L5	No.	15		
1.1.13	SE07 360° White ROBUS PRECENCE & PIR SENSOR	No.	4		
1.1.14	6W Decorative LED mirror light (copper) as JSL LIghtsLX 776	No.	12		
1.1.15	Philips GreenPerform Highbay Rectangular BY570X	No.	8		
1.1.16	Surface mountable, circular LED fitting as Fumagali GELMI 1G3.000 complete with LED bulbs "Type A2"	No.	8		
1.1.17	15 watts Circular LED fitting as Philips Essential Surface 1817lm, 3000K Cat No. 912500108781 "Type A5"	No.	18		
	TOTAL CARRIED FORWARD TO COLLECTION PAGE No. 6				

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF
ELECTRICAL INSTALLATIONS

ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
				KES	KES
1.2.00	**POWER POINTS AND OUTLETS**				
	Supply, install, test, commission and maintain:-				
1.2.01	13 Amp ring twin socket outlet points wired in 3 x 2.5sq mm PVC SC copper cables drawn in 20mm HG PVC conduits concealed in the wall and floors complete with all accessories but excluding the socket outlet plate	No.	50		
1.2.02	Ditto but for fused spur/hand dryer /water heater circuit	No.	18		
1.2.03	Borehole pump wired in 10.0 sq mm 4C PVC/SWA/PVC armored copper cable drawn in Cable trays and 50 dia HG sleeves concealed in the wall and floors complete with all accessories and three metres of 10.0sq. Mm 5 core flex but excluding isolator switch	LM	30		
1.2.04	Booster/Sump/Sprinkler pump wired in 4.0 sq mm 4C PVC/SWA/PVC armored copper cable drawn in Cable trays and 50 dia HG sleeves concealed in the wall and floors complete with all accessories and three metres of 10.0sq. Mm 5 core flex but excluding isolator switch	LM	30		
1.2.05	Cooker circuit wired in 3 x 6sq mm PVC SC copper cables drawn in 25mm HG PVC conduits concealed in the wall and floors complete with all accessories but excluding the cooker control unit	No.	5		
1.2.06	32A TP load break switch as Telemecanique Reference No. VC 2 G	No.	4		
1.2.07	63A TP load break switch as Telemecanique Reference No. VC 2 G	No.	1		
1.2.08	20A flush DP switch with pilot lamp as MK S8423 WHI	No.	18		
1.2.09	20A flex outlet as MK K 1090 WHI	No.	18		
1.2.10	13A 2 gang metalclad switchsocket-outlet as MK K 2947 ALM	No.	2		
1.2.11	13 A fused spur unit as MK K 370 WHI	No.	2		
1.2.12	13A flush 2 gang switchsocket-outlet as MK S2747DP WHI	No.	50		
1.2.13	250 x 50mm two compartment trunking surface mounted prepainted and baked steel trunking made out of 16 swg sheets and frame complete with cover, switch boxes, cross over bridges ,fixing accessories & faceplates	LM.	100		
1.2.14	45A DP cooker control unit with switchsocket-outlet as MK K 5236 WHI	No.	4		
	TOTAL CARRIED FORWARD TO COLLECTION PAGE No. 6				

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR ELECTRICAL INSTALLATIONS

ITEM	DESCRIPTION	UNIT	QTY.	RATE KES	AMOUNT KES
1.3.00	**CONDUIT WORK**				
	Supply, install, test, commission and maintain :-				
1.3.01	ICT outlet points comprising of 25 mm diameter HG PVC conduits concealed in walls and floor with all accessories excluding outlet plate	No.	28		
1.3.02	600 x 600 x 100mm prepainted steel adaptable box	No.	3		
1.3.03	50mm dia. H.G PVC conduit for linking the adaptable box concealed in the wall or floor with all accessories	LM.	100		
1.3.04	CCTV outlet points comprising of 25 mm diameter HG PVC conduits concealed in walls and floor with all accessories excluding outlet plate	No.	28		
	TOTAL CARRIED FORWARD TO COLLECTION PAGE No. 6				

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR ELECTRICAL INSTALLATIONS

ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
				KES	KES
1.4.00	**SUB-MAINS AND DISTRIBUTION**				
	Supply, install, test, commission and maintain :-				
1.4.01	8-way TPN distribution board "DBA CS1" as Schneider with a 100A TP integral Isolator , AFDD-RCBO Breakers,SPD,complete with the following:- 4 No. 10A SP MCB 4 No. 20A SP MCB 4 No.30A SP MCB 1 No.30A TP MCCB 1 No.63A TP MCCB 6 No. Blanking plates	No.	3		
1.4.02	Sub-mains comprising of 4C 16 sq mm PVC/SWA/PVC CU cable drawn in Cable trays and ducts from the switch board to the Distribution boards	LM	160		
1.4.03	Cables glands and lugs for the 16 sq mm 4 Core PVC SWA PVC cables complete with shroud	No.	6		
1.4.04	9-way SPN Consumer unit as Schneider ACTI 9 with an 100A SPN integral Isolator complete with the following: 1 No. 10A SP MCB 3 No. 20A SP MCB 1 No.30A SP MCB 1 No. 5A SP MCB 1 No.45A SP MCB 2 No. SP Blanking Plate	No.	4		
1.4.05	16 sq mm 2 core PVC SWA PVC armoured copper cable drawn in 50mm diameter conduits and trays complete with glands from theswitchboard to the consumer units at the Apartments	LM	80		
1.4.06	Cables glands and lugs for the 16 sq mm 2 Core PVC SWA PVC cables complete with shroud	No.	8		
	TOTAL CARRIED FORWARD TO COLLECTION PAGE No. 6				

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR ELECTRICAL INSTALLATIONS

ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
				KES	KES
	COLLECTION PAGE				
	BROUGHT FORWARD FROM PAGE No. 1				
	BROUGHT FORWARD FROM PAGE No. 2				
	BROUGHT FORWARD FROM PAGE No. 3				
	BROUGHT FORWARD FROM PAGE No. 4				
	ALLOW FOR A PROVISIONALCONTIGENCY				170,000.00
	TOTAL CARRIED FORWARD TO THE GRAND SUMMARY PAGE FOR ELECTRICAL INSTALLATIONS				

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF

POWER RETICULATION

ELECTRICAL INSTALLATIONS

ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
	POWER RETICULATION			KES	KES
1.1.00	**AREA LIGHTING**				
	Supply, install, test and commission:-				
1.1.01	4.0 sq mm 2 core PVC SWA PVC armoured copper cable drawn in ducts and trenches	LM.	150		
1.1.02	Cables glands and lugs for the 4.0 sq mm 2 Core PVC SWA PVC cables complete with shroud	No.	40		
1.1.03	150mm wide x 300mm long "HATARI " tiles	LM.	150		
1.1.04	Lucy connectors for looping the cables complete with all accessories	No.	40		
1.1.05	Earthing at every third street light pole with 15mm diameter 1500mm long copper earth electode and 2.5sq. Mm earting lead	No.	13		
1.1.06	30A D.P contactor with metal enclosure as Telemecanique GC1-M30	No.	1		
1.1.07	Lucy cut-out with 5A catridge fuse	No.	15		
1.1.08	Time switch as Telemecanique wired in 2.5 sq mm single core copper cable drawn in 20mm diameter HG PVC conduits complete with 300 x 300 x 75mm prepainted adaptable box	No.	1		
1.1.09	Decorative post-top lantern with symmetric distribution. Equipped with power reduction circuit, effective 3 hours before and 5 hours after a calculated midnight. It can be deactivated at installation with an easily accessible internal switch. Class II electrical, IP66, IK08. Base and arms: die-cast Aluminium (LM6), Canopy: spun Aluminium, all powder coated dark sandy grey 900 (close to RAL7043). Diffuser: clear Polycarbonate (PC). Screw fixings: stainless steel. Supplied complete in one box. Complete with 4100K LED LAMP AS THORN AVENUE F2 LED / AVN F2 LED 18L70 R/S BPSW CL2 D60 L740C/W 4 METER POWDER COATED BLACK DIE CAST 3 METRE MOUNTING POLE	No.	13		
	TOTAL CARRIED FORWARD TO PAGE NO.100				

SUMMARY PAGE

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF
ELECTRICAL INSTALLATIONS

	DESCRIPTION	**AMOUNT**
		KES
A	PRELIMINARIES	
B	TOTAL BROUGHT FORWARD FROM PAGE NO 6	
D	ALLOW FOR PROVISIONAL CONTINGENCY	100,000.00
	TOTAL FOR AREA LIGHTING CARRIED FORWARD TO GRAND SUMMARY PAGE FOR GENERAL ELECTRICAL INSTALLATIONS	

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF

POWER RETICULATION

ITEM	DESCRIPTION	UNIT	QTY.	RATE KES	AMOUNT KES
1.1.00	**POWER RETICULATION** **Supply, install, test, commission and maintain :-**				
1.1.01	Trenching, sifting and backfilling the duct trench after laying the ducts and compaction	LM	100		
1.1.02	2X150mm duct with 150 mm thick 1:3:6 concrete surround	LM	100		
1.1.03	600 x 600 x 450mm power concrete manhole complete with a Heavy Duty Cover cover	No.	6		
1.1.04	Allow for attendance and follow up for KP & LC services comprising of application for service line, service line installation, and meter connections,together with cable rerouting	Item	1		
1.1.05	600X150mm powder coated steel cable tray made out of 16 swg complete with mounting brackets,powder coated white in color	LM	20		
1.1.06	300X150mm powder coated steel cable tray made out of 16 swg complete with mounting brackets,powder coated white in color	LM	20		
1.1.07	Earth mesh comprising of 25 x 3mm copper tape complete with red soil, merconite and clamps, installed into the ground around the building and connected to the test clamps complete with all accessories	Item	1		
1.1.08	Earthing cable comprising of 1 run of 35 sq mm 1C SWA/PVC/SWA cable drawn in ducts	LM	20		
1.1.09	Free standing switch board to house 1 No. KPLC 3 Phase meter,fabricated from 16 SWG steel sheets and frames complete with Private Meters and the following:- - 2 NO. 200A TP/N ADJUSTABLE MCCBs AS SCHNEIDER TYPE D with Shunt trip - 1 No. 200A TP/N COPPER BUSBARS - 1 No. 200A TP/N AUTOMATIC CHANGEOVER - 1 No. 200A TP/N BYPASS CHANGEOVER SWITCH - 4 No. 63 A TP MCCB as SCHNEIDER TYPE D - 30KVAr automatic power factor Capacitor bank - Current,Voltage and power factor meters,TVSS Surge Protection Devices. The Switch board to be finished in auto lacquer, IP55 Degree of Protection and complete with all associated accessories as manufactured by Specialised Power Systems	Item	1		
	TOTAL CARRIED FORWARD TO COLLECTION PAGE No. 104				

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF

POWER RETICULATION

ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
				KES	KES
1.1.00	**POWER RETICULATION**				
	Supply, install, test, commission and maintain :-				
1.1.10	Allow for attendance to the Data cabling installations subcontractor	Item	1		
1.1.11	Allow for attendance to the security system installations subcontractor	Item	1		
1.1.12	Allow for attendance to the standby generator installations subcontractor	Item	1		
1.1.13	Allow for attendance and follow up for KP & LC services comprising of application for service line, service line installation, and meter connections	Item	1		
	TOTAL CARRIED FORWARD TO COLLECTION PAGE No. 104				

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF
ELECTRICAL INSTALLATIONS - POWER RETICULATION

ITEM	DESCRIPTION	UNIT	QTY	RATE KES	AMOUNT KES
	COLLECTION PAGE BROUGHT FORWARD FROM PAGE No. 101 BROUGHT FORWARD FROM PAGE No. 102 ALLOW FOR A PROVISIONAL CONTINGENCY				100,000.00
	TOTAL FOR POWER RETICULATION CARRIED FORWARD TO GRAND SUMMARY PAGE FOR GENERAL ELECTRICAL INSTALLATIONS				

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF

ICT RETICULATION

ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
	POWER RETICULATION			**KES**	**KES**
1.1.00	**ICT RETICULATION**				
	Supply, install, test and commission:-				
1.1.01	600 x 600 x 450mm power concrete manhole complete with a Heavy Duty Cover cover	No.	3		
1.1.02	2X150mm duct with 150 mm thick 1:3:6 concrete surround for linking the manholes complete with draw wire	LM	100		
1.1.03	Trenching, sifting and backfilling the duct trench after laying the ducts and compaction	LM	100		
1.1.04	300 x 300 x 150 mm prepainted steel adaptable box.	No.	2		
1.1.05	300mm Powder coated steel cable Tray made out of 16 swg complete with mounting brackets	LM	20		
	TOTAL FOR ICT RETICULATION CARRIED FORWARD TO GRAND SUMMARY PAGE FOR GENERAL ELECTRICAL INSTALLATIONS				

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF

RAZOR WIRE

ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
	POWER RETICULATION			**KES**	**KES**
1.1.00	**RAZOR WIRE FOR BOUNDARY WALL** Supply, install, test and commission:-				
1.1.01	3600 metres long, Galvanized Concertina Razor barbed wire with a width of 0.5 meters for the entire perimeter 16 gauge metal struts/brackets and 25 x 25mm square metal supports (700mm high) with insulators and all necessary accessories complete with the following: The squre metal suppors to be Hot-Dip Galvanized (HDG) Should be similar to supports done for electric fence complete with high quality insulatots. Assume 8 starnds of electric fence will be intalled in future. Maintain spacing of 2000mm between two supports NB.For the first phase only the supports and the razor wire will be done. The electric fence wires will follow in future. The supports in phase one will have insulators ready to receive the electric fence wires	LM	3,600		
	TOTAL FOR ICT RETICULATION CARRIED FORWARD TO GRAND SUMMARY PAGE FOR GENERAL ELECTRICAL INSTALLATIONS				

GRAND SUMMARY PAGE

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF

ELECTRICAL INSTALLATIONS

ITEM	DESCRIPTION	AMOUNT
		KES
A	PRELIMINARIES	
B	TOTAL BROUGHT FORWARD FOR GROUND FLOOR PARKING	
C	TOTAL BROUGHT FORWARD FOR AREA LIGHTING	
D	TOTAL BROUGHT FORWARD FOR POWER RETICULATION	
E	TOTAL BROUGHT FORWARD FOR ICT RETICULATION	
E	TOTAL BROUGHT FORWARD FOR RAZOR WIRE	
	TOTAL FOR ELECTRICAL INSTALLATIONS (VAT INCLUSIVE) CARRIED FORWARD TO GRAND SUMMARY	0.00

[redacted]

STRUCTURED CABLING INSTALLATIONS

[redacted]

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF

STRUCTURED CABLING INSTALLATIONS

ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
				KES	KES
	Supply, install, test and commission the following items. The installations to be tested using Network scanner, documented and labelled				
1.1.01	Telecommunication outlet point comprising wiring with 4-pair 0.5mm shielded copper wire PVC insulated and PVC sheathed (Cable Part No. 9A6M4-A5) drawn into installed trunking and conduits to meet category 6A of TIA PN - 3727 and class E of ISO/ IEC 11801 requirements but excluding outlet plates, all accessories included, as Siemon Color coded as per the engineers instructions and outdoor rated for external services	No.	26		
1.1.02	UTP CAT 6A twin RJ 45 outlet plates as Siemon or equal and approved	No.	26		
1.1.03	CAT 6A shielded loaded Patch Panel - 48 ports as Siemon flat 1 u black (Z6AS-PNL-U48K)	No.	1		
1.1.04	2 HU Patch guide as Siemon (Multi-access Horizontal cable manager-RWM-I)	No.	1		
1.1.05	CAT 6A 3 metres shielded patch cords - with RJ45 - RJ45 as Siemon ZM6A-S03M-02B	No.	26		
1.1.06	CAT 6A one metre shielded patch cords with RJ45 as Siemon ZM6A-SO1M-02B	No.	26		
1.1.07	Networking Accessories comprising of masking tapes,labels, cable ties etc	LOT	1		
1.1.08	15U wall mounted metal cabinet with mesh door, trays, fans and 1 No.power sockets and V - organisers	No.	2		
1.1.09	Complete earthing of all cabinets to IEE requirements comprising of 16sq mm ECC, connected to the electrical installations earthing complete with all accessories (Earth rods, Copper Plates and Grounding Key)	Item	2		
1.1.10	HPE Aruba Aruba 6000 24G Class4 PoE 4SFP 370W Switch (R8N87A) including fiber uplink ports and warranties	No.	2		
1.1.11	High voltage surge protector as Solatec	No.	2		
1.1.12	1HU patch cord organisers as Siemon or equal and approved	No.	2		
1.1.13	1.5 KVA 240V single phase rackmount APC UPS	No.	2		
	TOTAL CARRIED FORWARD TO COLLECTION PAGE NO.3				

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF
STRUCTURED CABLING INSTALLATIONS

ITEM	DESCRIPTION	UNIT	QTY.	RATE KES	AMOUNT KES
	Supply, install, test and commission the following items. The installations to be tested using Network scanner, documented and labelled				
1.1.14	8 core Siemon outdoor optic fibre cable (Multimode - 9F5D4-4A1.00) to link the Training Block to the existing server room and terminated using J4858C transceivers modules	LM	100		
1.1.15	Fibre patch panel as Siemon (FCP3-RACK)	No	3		
1.1.16	SC MM Duplex connectors as Siemon (FC2-SC-MM-B80-B)	No	6		
1.1.17	Fibre patch cords LC - SC duplex as Siemon (FJ2-LCSC5L-01AH)	No	6		
1.1.18	6 core fibre termination block	No.	2		
1.1.19	5 metre multi mode fibre jumpers	No.	2		
1.1.20	Fluke test for all the outlet points	Item	1		
1.1.21	Any other Item required to complete these works	Item	1		
1.1.22	Yealink SIP- T34W	No.	17		
1.1.23	Yealink T46G	No.	1		
1.1.24	Yeastar P520 IP PBX, with all licenecs and configuration	No.	1		
	TOTAL CARRIED FORWARD TO COLLECTION PAGE NO.3				

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF
STRUCTURED CABLING INSTALLATIONS

ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
				KES	KES
	COLLECTION PAGE				
	BROUGHT FORWARD FROM PAGE No. 1				
	BROUGHT FORWARD FROM PAGE No. 2				
	ALLOW FOR A PROVISIONALCONTIGENCY				250,000.00
	TOTAL CARRIED FORWARD TO THE SUMMARY PAGE				

SUMMARY PAGE

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF

STRUCTURED CABLING INSTALLATIONS

ITEM	DESCRIPTION	AMOUNT KES
A	PRELIMINARIES	
B	TOTAL FOR STRUCTURED CABLING B/F FROM PAGE NO. 3	
	TOTAL CARRIED FORWARD TO THE GRAND SUMMARY PAGE FOR ELECTRICAL SERVICES (VAT INCLUSIVE)	

[redacted]

CCTV INSTALLATIONS

[redacted]

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF

CCTV INSTALLATIONS

ITEM	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
				KES	KES
	Supply, install, test and commission the following:-				
2.1.01	Telecommunication outlet point comprising wiring with 4-pair 0.5mm shielded copper wire PVC insulated and PVC sheathed (Cable Part No. 9A6M4-A5) or Giganet UK drawn into installed trunking and conduits to meet category 6A of TIA PN - 3727 and class E of ISO/ IEC 11801 requirements but excluding outlet plates, all accessories included, as Siemon Color coded as per the engineers instructions and outdoor rated for external services	LM	700		
2.1.02	UNIVIEW 4MP IPC324LB-AF28(40)-A2 Dome Network Camera	No.	4		
2.1.03	Uniview 4MP IPC2124LB-AF28(40)K-A2 Bullet Network Camera	No.	18		
2.1.05	UNIVIEW 34 CHANNEL NVR302-32S with 8TB storage	Item	1		
2.1.06	55" high resolution performance colour monitor/TV screen as Samsung SMART 4K LED TV or equal and approved c/w all mounting brackets and accessories including HDMI cables	Item	1		
2.1.08	HPE Aruba Aruba 6000 24G Class4 PoE 4SFP 370W Switch (R8N87A) including fiber uplink ports and warranties	No.	2		
2.1.09	UTP CAT 6A Patch Panel - 24ports as Siemon	No.	2		
2.1.10	Networking Accessories comprising of masking tapes,labels, cable ties etc	LOT	1		
2.1.11	1U patch cord organisers as Siemon or equal and approved	No.	2		
2.1.12	8 core Siemon/Giganet outdoor optic fibre cable (Multimode - 9F5D4-4A1.00) to link the Block to the existing server room and terminated using J4858C transceivers modules	LM	150		
2.1.13	All necessary connections and power adaptors for the fiber cable in item 1.1.12 including SFPs,etc	Item	1		
2.1.14	Fluke test for all the outlet points	Item	1		
2.1.15	CAT 6A one metre shielded patch cords with RJ45 as Siemon ZM6A-SO1M-02B	No.	16		
2.1.17	Any other item required to complete these works	LOT	1		
	TOTAL CARRIED FORWARD TO SUMMARY PAGE				

GRAND SUMMARY PAGE

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF

CCTV INSTALLATIONS

ITEM	DESCRIPTION	**AMOUNT** **KES**
A	PRELIMINARIES	
B	TOTAL FOR CCTV INSTALLATIONS B/F FROM PAGE NO. 3	
	TOTAL CARRIED FORWARD TO THE GRAND SUMMARY PAGE (VAT INCLUSIVE)	

[redacted]

GRAND SUMMARY PAGE FOR ELECTRICAL SERVICES INSTALLATIONS

[redacted]

GRAND SUMMARY PAGE

THE PROPOSED BOUNDARY WALL AND ANCILLARY BUILDINGS ON PLOT LR. NO 20589, MACHAKOS FOR NSSF

ELECTRICAL SERVICES INSTALLATIONS

ITEM	DESCRIPTION	AMOUNT
		KES
B	TOTAL BROUGHT FORWARD FOR GENERATOR INSTALLATIONS	
C	TOTAL BROUGHT FORWARD FOR GENERAL ELECTRICAL INSTALLATIONS	
D	TOTAL BROUGHT FORWARD FOR STRUCTURED CABLING INSTALLATIONS	
E	TOTAL BROUGHT FORWARD FOR CCTV INSTALLATIONS	
F	ALLOW PC SUM FOR INCOMING KPLC INSTALLATIONS	
	TOTAL FOR ELECTRICAL SERVICES INSTALLATIONS (VAT INCLUSIVE) CARRIED FORWARD TO GRAND SUMMARY FOR MAIN WORKS	