REPUBLIC OF KENYA

KENYA INDUSTRIAL RESEARCH AND DEVELOPMENT INSTITUTE

THE PROPOSED PHASE 2 WORKS FOR THE PROPOSED RESEARCH, TECHNOLOGY AND INNOVATION LABORATORIES AND RELATED INFRASTRUCTURE ON PLOT L.R. NO. 209/5811, DUNGA ROAD, SOUTH 'B', NAIROBI

FINANCIAL PROPOSAL

STRUCTURED CABLING, CCTV, EPABX &ACCESS CONTROL INSTALLATION WORKS
TENDER REF NO: KIRDI 06/1/2025/2026

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TECHNICAL SPECIFICATION AND BILLS OF QUANTITIES FOR STRUCTURED CABLING, CCTV, EPABX &ACCESS CONTROL INSTALLATION WORKS

PART A: GENERAL SPECIFICATION OF MATERIALS AND WORKS

1.1 SHOP DRAWINGS

Before manufacture or Fabrication is commenced the sub-contractor shall submit Two copies of detailed drawings of all control pillars, meter cubicles, medium voltage switchboards including their components showing all pertinent information including sizes, capacities, construction details, etc, as may be required to determine the suitability of the equipment for the approval of the Engineer. Approval of the detailed drawings shall not relieve the sub-contractor of the full responsibility of errors or the necessity of checking the drawings himself or of furnishing the materials and equipment and performing the work required by the plans and specifications.

1.2 RECORD DRAWINGS

These diagrams and drawings shall show the completed installation including sizes, runs and arrangements of the installation. The drawings shall be to scale not less than 1:50 and shall include plan views and section.

The drawings shall include all the details which may be useful in the operation, maintenance or subsequent modifications or extensions to the installation.

Three sets of diagrams and drawings shall be provided, all to the approval of the Engineer.

One colored set of line diagrams relating to operating and maintenance instructions shall be framed and, mounted in a suitable location.

1.3 REGULATIONS AND STANDARDS

All work executed by the Sub-contractor shall comply with the current edition of the “Regulations” for the Electrical Equipment of Buildings, issued by the Institution of Electrical Engineers, and with the Regulations of the Local Electricity Authority.

Where the two sets of regulations appear to conflict, they shall be clarified with the Engineers. All materials used shall comply with relevant Kenya Bureau of Standards Specification.

1.4 SETTING OUT WORK

The sub-contractor at his own expenses; is to set out works and take all measurements and dimensions required for the erection of his materials on site; making any modifications in details as may be found necessary during the progress of the works, submitting any such modifications or alterations in detail to the Engineer before proceeding and must allow in his Tender for all such modifications and for the provision of any such sketches or drawings related thereto.

1.5 POSITIONS 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.

of cables must be agreed on site with the Engineer before any work is carried out.

1.6 MCB DISTRIBUTION PANELS AND CONSUMER UNITS

All cases of MCB Panels and consumer units shall be constructed in heavy gauge sheet with hinged covers.

Removable undrilled gland plates shall be provided on the top and bottom of the cases. Miniature circuit breakers shall be enclosed in moulded plastic with the tripping mechanism and arc chambers separated and sealed from the cable terminals.

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 shall be incorporated.

The tripping mechanism shall be on inverse characteristic to prevent tripping in temporary overloads and shall not be affected by normal variation in ambient temperature.

A locking plate shall be provided for each size of breaker; A complete list of circuit details 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 the lids of each distribution panel. The appropriate MCB ratings shall be stated on the circuit chart against each circuit in use: Ivorine labels shall be secured to the insulation barriers in such a manner as to indicate the number of the circuits shown on the circuit chart.
Insulated barriers shall be fitted between phases, and neutrals in all boards, and to shroud live parts.

Neutral cables shall be connected to the neutral bar in the same sequence as the phase cables are connected to the MCB's. This shall also apply to earth bars when installed.

1.7 FUSED SWITCHGEAR AND ISOLATORS

All fused switchgear and isolators whether mounted on machinery, walls or industrial panels shall conform to the requirements of KS 04 – 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.

Fuse links for fused switches are to be of high rupturing capacity cartridge type, conforming to KS 04 – 183: 1978.

Isolators shall be load breaking/fault making isolators.

Fused switches and isolators are to have separate metal enclosures. Mechanical interlocks are to be provided between the door and main switch operating mechanism 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. In T.P & N fused switch units, bolted neutral links are to be fitted.

1.8 CONDUITS AND CONDUIT RUNS

Conduit systems are to be installed so as to allow the loop-in system of wiring:

All conduits shall be black rigid super high impact heavy gauge class 'A' PVC in accordance with KS 04 – 179: 1988 and IEE Regulations. No conduit less than 20mm in diameter shall be used anywhere in this installation.

Conduit shall be installed buried in plaster work and floor screed except when run on wooden or metal surface when they will be installed surface supported with saddles every 600mm. Conduit run in chases shall be firmly held in position by means of substantial pipe hooks driven into wooden plugs.

The Sub-contractor's attention is drawn to the necessity of keeping all conduits entirely separate from other piping services such as water and no circuit connections will be permitted between conduits and such pipes. All conduits systems shall be arranged wherever possible to be self-draining to switch boxes and conduit outlet points for fittings:

The systems, 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; before wiring all conduit, systems shall be carried out until the particular section of the conduit installation is complete in every respect.

The sets and bends in conduit runs are to be formed on site using appropriate size bending springs and all radii of bends must not be less than 2.5 times the outside diameter of the conduit. No solid or inspection bends, tees or elbows will be used.

Conduit connections shall either be by a demountable (screwed up) assembly or adhesive fixed and water tight by solution. The tube 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, and care shall be taken that no rough edges of conduit stick out into the boxes.

Runs between draw in boxes are not to have more than two right angle bends or their equivalent. The sub-contractor may be required to demonstrate to the Engineers that wiring in any particular run is easily withdraw able and the sub-contractor may, at no extra cost to the contract; be required to install additional draw-in boxes required. If conduit is installed in straight runs in excess of 6000mm, expansion couplings as manufactured by Egatube shall be used at intervals of 6000mm.

Where conduit runs are to be concealed in pillars and beams, the approval of the Structural Engineer, shall be obtained. The sub-contractor shall be responsible for marking the accurate position of all holes, chases etc, on site, or if the Engineer so directs, shall provide the Main Contractor with dimensional drawings to enable him to mark out and form all holes and chases. Should the sub-contractor fail to inform the main contractor of any inaccuracies in this respect they shall be rectified at the sub-contractor's expense.

It will be the Sub-contractor's responsibility to ascertain from site, the details of reinforced concrete or structural steelwork and check from the builder's drawings the 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.

The drawings provided with these specifications indicate the appropriate positions only of points and switches, and it shall be the Sub-Contractors responsibility to mark out and centre on site the accurate positions where necessary in consultation with the Architect and the Engineer. The sub-contractor alone shall be responsible for the accuracy of the final position.

1.9 CONDUIT BOXES AND ACCESSORIES

All conduit outlets and junction boxes are to be either malleable iron and of standard circular pattern of the appropriate type to suit saddles being used or super high impact PVC manufactured to KS 04 – 179: 1983.

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 conduit, standard pattern through boxes are to be used:

Boxes are to be not less than 50mm 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.

Outlet boxes for lighting fittings are to be of the loop-in type where conduit installation is concealed and the sub-contractor shall allow one such box per fitting, except where fluorescent fittings are specified when two

such boxes per fitting shall be fitted flush with ceiling and if necessary, fitted with break joint rings. Pattresses shall be fitted where required to outlets on surface conduit runs.

Adaptable boxes are to be of PVC or mild steel (of not less than 12swg) and black enameled or galvanized finish according to location. They shall be of square or oblong shape location. They shall be of square or oblong shape complete with lids secured by four 2 BA brass roundhead 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 conduit bushes.

2.0 LABELS

Labels fitted to switches and fuse boards; -

(i) Shall be Ivorine engraved black on white.

(ii) Shall be secured by R.H brass screws of same manufacturing throughout.

(iii) Shall be indicated on switches: -
- a) Reference number of switches
- b) Special current rating
- c) Item of equipment controlled

(iv) Shall indicate on MCB panels
- a) Reference number
- b) Type of board, i.e.; lighting, sockets, etc,
- c) Size of cable supplying panel
- d) where to isolate feeder cable

(v) Shall be generally not less than 75mm x 50mm.

2.1 EARTHING

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

(i) It shall be carried out in accordance with the appropriate sections of the current edition of the Regulations, for the Electrical Equipment of Buildings issued by Institute of Electrical Engineers of Great Britain.

(ii) At all main distribution panels and main service positions a 25mm x 3mm minimum cross-sectional area Copper tape shall be provided and all equipment including the lead sheath and armouring of cables, distribution boards and metal frames shall be bonded thereto.

(iii) The earth tape in Sub-clause (ii) shall be connected by means of a copper tape or cable of suitable cross-sectional area to an earth electrode which shall be a copper earth rod (see later sub-clause).

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

(v) 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 point of entry to the tape, for isolating the earth electrode for testing purposes.

(vi) Earthing of sub-main equipment shall be deemed to be satisfactory where the sub-main cables are M.I.C.S. or conduit with separate earth wire, and installation is carried out in accordance with the figures stated in the current edition of the I.E.E Regulations.

(vii) Where an earth rod is specified (see Sub-clause (iii) it shall be proprietary manufacture, solid hand drawn copper of 15mm diameter driven into the ground to a minimum depth of 3.6m. It shall be made up to 1.2m sections with internal screw and socket joints and fitted with hardened steel tip and driving cap.

(viii) Earth plates will not be permitted

(ix) Where an earth rod is used the earth resistance shall be tested in the manner described in the current edition of the IEE Regulations, by the Sub-Contractor in the presence of the Engineer and the Sub-Contractor shall be responsible for the supply of all test equipment.

(x) Where copper tape is fixed to the building structure it structures it shall be by means of purpose made non-ferrous saddles which space the conductor away from the structure a minimum distance of 20mm. Fixings, shall be made using purpose made plugs; No fixings requiring holes to be drilled through the tape will be accepted.

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

(xii) Where holes are drilled in the earth tape for connection to items of equipment the effective cross-sectional area must not be less than required to comply with the IEE regulations.

(xiii) Bolts, nuts and washers for any fixing to the earth tape must be of non-ferrous material.

(xiv) Attention is drawn to the need for the earthing metal parts of lighting fittings and for bonding ball joint suspension in lighting fittings.

2.2 ACABLES AND FLEXIBLE CORDS

All cables used in this Sub-Contract shall be manufactured in accordance with the current appropriate Kenya standard Specification which are as follows: -

P.V.C. Insulated Cables and Flexible Cords	-	Ks 04-192:1988
PVC Insulated Armoured Cables	-	Ks 04-194:1990
Armouring of Electric cables	-	Ks 04-290:1987

The successful Sub-Contractor will, at the Engineers discretion be required to submit samples of cables for the Engineers approval; the Engineer reserves the right to call for the cables of an alternative manufacture without any extra cost being incurred.
P.V.C. insulated cables shall be 500/1000-volt grade. No cables smaller than 1.5mm² shall be used unless otherwise specified. The installation and the finish of cables shall be as detailed in later clauses. The colour of cables shall conform with the details stated in the "Cable Braid and insulation Colours" Clause.

2.3 ARMOURED P.V.C. INSULATED AND SHEATHED CABLES

Shall be 600/1000-volt grade manufactured to Ks 04-194:1988 and Ks 04-187/188 with copper stranded conductors.

The wire armour of the cable shall be used wholly as an earth continuity conductor and the resistance of the wire armour shall have a resistance not more than twice of the largest current carrying conductor of the cable.

P.V.C./S.W.A./P.V.C. cables shall be terminated using "Telecom" "B" type or approved equal or approved equal glands and a P.V.C. tapered sleeve shall be provided to shroud each gland.

Where cables rise from floor level to switchgear etc., they shall be protected by P.V.C. conduit, to a height of 600mm from finished floor level, whether the cable is run on the surface or recessed into the wall.

2.4 CABLE SUPPORTS, MARKERS AND TILES

All PVC/SWA/PVC cables run inside the building shall be fixed in rising ducts or on ceilings by means of die cost cables hooks or clamps, or appropriate size to suit cables, fixed by studs and back nuts to their channel sections.

Alternatively, fixing shall be by BICC claw type cleating system with die-cast cleats and galvanized mild steel back straps or similar approved equal method. For one or two cables run together the cleats shall be fixed a special channel section supports or back straps described above which shall in turn be secured to walls or ceilings of ducts by raw bolts.

In excessively damp or corrosive atmospheric conditions special finishes may be required and the Sub-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 blackstrap shall also be used for securing cables in vertical ducts.

Cables supports shall be fixed at 600mm maximum intervals, the supports being supplied and erected under this Sub-contract. Saddles shall not be used for supporting cables nor any other type of fixing other than one of the two methods described above or other system which has received prior approval of the Engineer;

Cables are to be kept clear of all pipe work and the Sub-contractor shall work in close liaison with other services Sub-contractors.

The Sub-Contractor shall include for the provision of fixing of approved type coloured slip on cables end markers to indicate permanently the correct phase and neutral colours on all ends.

Provision shall be made for supplying and fixing approved non-corrosive metal cable markers to be attached to the outside of all PVC/SWA/PVC cables at 15mm intervals indicating cable size and distinction.

Where PVC/SWA/PVC cables are outside the building they shall be laid underground 750mm deep with protecting concrete interlocking cover tiles laid over which shall be provided and laid under this Sub-contract.

All necessary excavations and reinstatement of ground including sanding or trenches will be carried out by the Sub-Contractor, unless otherwise stated

2.5 PVC INSULATED CABLES

Shall be of non-braided type as CMA reference 6491 x 600/1000/1000-volt grade cables, or equal approved.

PVC cables shall conform to the details of the “Cables and Flexible cords” and “Cable Braid and Insulation Colours” clauses.

2.6 HEAT RESISTING CABLES

Final connections to cookers, water heaters, etc., shall be made using butyl rubber insulated cable as CMA reference 610 butyl (Single core 600/1000 Volt).

This type of cable shall be used in all instances where a temperature exceeding 100°F, but not exceeding 150°F is likely to be experienced. Final connections to all lighting fittings (and other equipment where a temperature in excess of 150°c likely to be experienced) shall be made using silicon rubber insulated cable or equal and approved.

2.7 FLEXIBLE CORDS

Shall be in accordance with the "Cable and Flexible Cords" clause. No cord shall be less than 24/0.2mm in size unless otherwise specified.

Circular white twin TRS flex shall be used for plain pendant fittings up to 100 watts. For all other types of lighting fittings, the flexible cable shall be silicone rubber insulated.

No polythene insulated flexible cable shall be used in any lighting fitting or other appliance (see "Heat Resisting Cables" Clause 30).

2.8 CABLE ENDS AND PHASE COLOURS

All cable ends connected up in switchgear, MCB panels etc; shall have the insulation carefully cut back and the ends sealed with Heller man rubber slip on cable end markers.

The markers shall be of appropriate phase colour for switch and all other live feeds to the details of the "Cable Insulation Colours" clause. Black cable with black end markers shall only be used for neutral cables.

CABLE INSULATION COLOURS

Unless otherwise stated in later clauses the insulation colours shall be in accordance with the following table.

Where other systems are installed the cable colours shall be in accordance with the details stated in the appropriate clause

System	Insulation Colour	Cable End Marked
Main and Sub-Main Circuits		
a) Phase	Red	Red
b) Neutral	Black	Black
Sub-Circuits (Single Phase)		
a) Phase	Red	Red
b) Neutral	Black	Black

2.9 SUB-CIRCUIT WIRING

For all lighting and sockets wiring shall be carried out in the "looping in" system and there shall be no joints whatsoever. No lighting circuits shall comprise more than 20 points when protected by 10A MCB. Cables with different cross-section area of copper shall not be used in combination.

Lighting circuits P. V.C. cable 1.5mm² for all lighting circuits indicated on the drawing.
Power circuits P.V.C cable (minimum sizes).

(i) 2.5mm² for one, two or three 5Amp sockets wired in parallel.

(ii) 2.5mm² for one 15Amp socket.

(iii) 2.5mm² for maximum of ten switched 13 Amp sockets wired from 30 Amp MCB.

The wiring sizes for lighting circuits and sockets are shown on the drawings. In such cases, the sizes shown on the drawings shall prevail over the sizes specified.

Wiring sizes for other appliances shall be shown on the drawing or specified in later clauses of this specification

2.10 SPACE FACTOR

The maximum number of cables that may be accommodated in a given size of conduit or trunking or duct is not to exceed the number in Tables B.5 and B.6 or as stated in Regulation B.91, B.117 and B.118 of the I.E.E Regulations whichever is appropriate.

2.11 INSULATION

The insulation resistance to earth and between poles of the whole wiring system, fittings and lumps, shall not be less than the requirements of the latest edition of the I.E.E Regulations. Complete tests shall be made on all circuits by the Sub-contractor before the installations are handed over.

A report of all tests shall be furnished by the Sub-Contractor to the Engineer. The Engineer will then check test with his own instruments if necessary.

2.12 LIGHTING SWITCHES

These shall be mounted flush with the walls, shall be contained in steel or alloy boxes and shall be of the gang's ratings and type shown in the drawings. They shall be as manufactured by M.K. Electrical Ltd., or other equal and approved to KS 04 – 247: 1988

2.13 SOCKETS AND SWITCHED SOCKETS

These shall be flush pattern in steel/pvc box and shall be of the gangs and type specified in the drawings.

They shall be 13- Amp, 3-pin, shuttered, switched and as manufactured by "M.K. Electrical Co. Ltd.", or other approved equal to KS 04 – 246: 1987

2.14 FUSED SPUR BOXES

These shall be flush, D.P switched as in steel/pvc box and of type and make specified in the drawings complete with pilot light and as manufactured by "M. K. Electrical Company Ltd", or other approved equal. KS 04 – 247: 1988

2.15 COOKER OUTLETS

These shall be flush mounted with 13-A switched socket outlet and neon indicator Lamps.
The cooker control units shall be as manufactured by "M.K. Electrical Company Ltd", or another approved equal KS 04 – 247: 1988

2.16 CONNECTORS

Shall be specified in the drawings and appropriate rating. These shall be fitted at all conduit box lighting point outlets for jointing of looped P.V.C cables with flexible cables of specified quality.

2.17 LAMPHOLDERS

Shall be of extra heavy H.O skirted and shall be provided for every specified lighting fitting and shall be B.C; E.S; or G.E.S as required. All E.S. and G.E.S. holders shall be heavy brass type (except for plain pendants where the reinforced Bakelite type shall be used). The screwed cap of the E.S and G.E.S. holders shall be connected to the neutral.

Where lamp holders are supported by flexible cable, the holders shall have “cord grip” arrangements and in the case of metal shades earthing screws shall be provided on each of the holders.

The Sub-Contractor must order the appropriate type of holder when ordering lighting fittings, to ensure that the correct types of holders are provided irrespective of the type normally supplied by the manufacturers.

2.18 LAMPS

All lamps shall be suitable for normal stated supply voltage and the number and sizes of lamps detailed on the drawings shall be supplied and fixed. The Sub-Contractor must verify the actual supply voltage with the supply authority before ordering the lamps.

2.19 LIGHTING FITTINGS AND STREET LIGHTING LANTERNS

ALL LIGHT FITTINGS SPECIIFIED SHALL BE OF THE LED TYPE.

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This Sub-Contract shall include for the provision, handling charges, taking the delivery, safe storage, wiring (including internal wiring) assembling and erecting of all lighting fittings shown on the drawings.

All fittings and pendants shall be fixed to the conduit boxes with brass R/H screws. These to be in line with metal finish of fittings. The lighting fittings are detailed for the purpose of establishing a high standard of finish and under no circumstances will substitute fittings be permitted.
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 box fittings. Supports shall be provided and fixed by the Sub-Contractor.

The whole of the metal work of each lighting fittings shall be effectively bonded to earth. In the case of ball and/or knuckle joints short lengths of flexible cable shall be provided, bonded to the metal work on either side of the joints. If the above provisions are not made by the manufacturers -, the Sub-contractor shall include cost of additional work necessary in his tender. See “Flexible Cords” clause for details of internal wiring of lighting fittings. Minimum size of internal wiring shall be 20/0.20mm (23/0067). Each lighting fitting shall be provided with number type and size of lamps as detailed on the drawings. It is to be noted that some fittings are suspended as shown on the drawings.

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 up vertically or horizontally on the centre lines of the units concerned.

Normally, the units shall be lined up on vertical centre lines, but where it is necessary to mount units at low level, they shall be lined up horizontally.

2.20 POSITIONS OF POINTS AND SWITCHES

Although the approximate positions of all points are shown on the drawings, enquiry shall be made as to the exact positions of all M.C.B panels, lighting points, socket outlets etc, before work is actually commenced. The Sub-contractor must approach the Architect with regard to the final layout of all lights on the ceiling and walls.

The Sub-contractor must consult with the Engineer in liaison with the Clerk of Works, or the General Foreman on site regarding the positions of all points before fixing any conduit etc. The Sub-Contractor shall be responsible for all alterations made necessary by the non-compliance with the clause.

2.21 STREET/SECURITY OUTDOOR LIGHTING COLUMNS:

The column shall be at a minimum of 225mm in the ground on 75mm thick concrete foundations and the pole up to 150mm shall be surrounded with concrete. The top bracket and plain section of the columns shall be common to and interchangeable with all brackets with maximum mismatching tolerance of 3mm between any pole and bracket. After manufacture 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 columns shall be

painted with one undercoat and two coats of gloss paint to an approved colour. All columns shall be complete with fused cut-outs.

2.22 TIMING CONTROL SWITCH

These shall be installed where shown on the drawings. Photocell timing control circuits which will operate 'on' with a specified level of darkness and 'off' with a given level of light. The initial adjustment will be done with approval of the Electrical Engineer.

2.23 `WIRING SYSTEM FOR STREETLIGHTING

Cables shall be as indicated on the drawings, and shall be laid in a cable trench 450mm deep along the road sides and 600mm deep across the roads and 900mm away from the road kerb or 1500mm away from the edges of the road. 'Loop-in' and 'Loop-out' arrangement shall be used at every pole. Wiring to the lanterns on each pole shall be with 1.5mm² PVC twin insulated and sheathed cable with earth wire shall be laid at least 600mm below the finished road level on a compact bed of marram at least 50mm thick and covered with a concrete surrounded 150mm thick.

2.24 METAL CONTROL PILLAR

These shall be metal clad and fabricated as per contract drawings and specification. The Sub-Contractor shall supply, install, test and commission control pillars including supplying, fixing connecting switchgears as detailed on the appropriate drawings.

2.25 CURRENT OPERATED EARTH LEAKAGE CIRCUIT BREAKER

Current operated earth leakage circuit breaker shall conform to B.S.S. 4293:68 rated at 240 volts D.P. 50 cycles A.C. Mains.

The breaker shall be provided with test switch and fitted in weather proof enclosure for surface mounting. The rated load current and earth fault operating current shall be as specified in the drawings. These shall be as manufactured by Crabtree, Siemens or other equal and approved.

2.26 M.V. SWITCHBOARD AND SWITCHGEAR

The switchboard shall be manufactured in accordance with KS04-226 which co-ordinates 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 equipment and material used in the switchboard shall be in accordance with the appropriate Kenya Standard.

The switchboard shall comprise the equipment shown on the drawings together with all current transformers, auxiliary fuses, labels, small wiring and interconnections necessary for the satisfactory operation of the switchboard

Switchboard shall be of the flush fronted, enclosed, metal clad type with full front or rear access as called for in the particular specifications, suitable for indoor use, sectionalized as necessary to facilitate transport and erection. The maximum height of the switchboard is to be approximately 2.0 meters. A suitable connection chamber containing all field terminals shall be provided at the top or bottom of the switchboard as appropriate.

Before manufacture, the Sub-Contractor shall submit to the consulting Engineer for approval of detailed drawings showing the layout, construction and connection of the switchboard.

All bus-bars and bus-bar connections shall consist of high conductivity copper and be provided in accordance with KS 04-226: 1985. The bus-bars shall be clearly marked with the appropriate phase and neutral colours which should be red, yellow, blue for the phases and black for neutral. The bus-bars shall be so arranged in the switchboard that the extensions to the left and right may be made in the future with ease should the need arise.

Small wiring, which will be neatly arranged and cleated, shall be executed in accordance with B.S. 158 and the insulation of the wiring shall be colored according to the phase or neutral connection.

Switches and fuse switches, shall be in strict accordance with KS04-183:1978 Class 2 switches. Means of locking the switch in the "OFF" position shall be provided.

All fuse switches shall comply with KS04-183:1978, PARTS 2 and 3 a fault rating at least equal to the fault rating of the switchboard in which they are installed. Cartridge fuse links to KS 04-183:1978 category A.C. 46, class Q1 and fusing factor not exceeding 1.5 shall be supplied with each fused switch.

Mounting arrangements shall be such that individual complete fuse switches 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. Means of locking the switch in the "OFF" position shall be provided.

2.27 STEEL CONDUITS AND STEEL TRUNKING

Conduits shall be of heavy gauge class "B" welded to Standard specification KS 04-180:1985. In no case will conduit smaller than 20mm 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 galvanized. Conduit fittings, accessories or equipment used in conjunction with galvanized conduits shall also be galvanized or otherwise as approved by the service engineer.

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 or the building at intervals of not less than 1.2m. Joint trunking shall not overhang fixing points by more than 0.5m.

All trunking shall be made electrically continuous by means of 25 x 3mm copper links across each joint and where the trunking is galvanized, the links shall be made by galvanized flat iron strips.

All trunking fittings (i.e. Bends, tees, etc) shall leave the main through completely clear of obstructions 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 cables larger than 35mm² are employed.

Where trunking passes through ceilings and walls the cover shall be solidly fixed to 150mm 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.

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

Where 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.

Where a wiring system incorporates galvanized conduit and trunking, the trunking shall be deemed to be Powder Coated unless specified otherwise.

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.

Conduit and trunking shall be mechanically and electrically continuous. Conduit shall be tightly screwed between the various lengths so that they butt at the socketed joints. The internal edges of conduit and all fittings shall be smooth, free from burrs and other defects. Oil and any other insulating substance shall be

removed from the screw threads; where conduits terminate in fuse-gear, distribution boards, adaptable boxes, non-spouted switchboxes, etc., they shall, unless otherwise stated, be connected thereto by means of smooth bore male brass bushes, compression washers and sockets. All exposed threads and abrasions shall be painted using an oil paint for black enameled tubing and galvanizing paint for galvanized tubing immediately after the conduits are erected. All bends and sets shall be made cold without altering the section of the conduit. The inner radius of the bed shall not be less than four (4) times the outside diameter of the conduit. Not more than two right angle bends will be permitted without the inter-position of a draw-in-box. Where straight runs of conduit are installed, draw-in-boxes shall be provided at distances not exceeding 15mm. No tees, elbows, sleeves, either of inspection or solid type, will be permitted.

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.

Conduits and trunking shall be run at least 150mm clear of hot water and steam pipes, and at least 75mm clear of cold water and other services unless otherwise approved by the services engineer.

All boxes shall conform to KS 04 – 668: 1986, to be of malleable iron, and black enameled or galvanized according to the type of conduit specified. All accessory boxes shall have threaded brass inserts.

Box lids where required shall be heavy gauge metal, secured by means of zinc plated or cadmium plated steel screws.

All adaptable boxes and lids of the same size shall be interchangeable.
Boxes used on surface work are to be tapped or drilled to line up with the conduit fixed in distance type saddles allowing clearance between the conduit and wall without the need for setting the conduit.

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

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 services engineer and covered and by the suitable floor traps, with non-ferrous trays and covers.

The floor trap covers are to be recessed and filled in with a material to match the floor surface.

The Sub-contractor must take full responsibility for the filling in of all covers, but the filling in material will be supplied and the filling carried out by the main building contractor.

Where buried in the ground outside the building the whole of the buried conduit is to be painted with two coats of approved bit mastic composition before covering up.

Where run on the surface, unpainted fittings and joints shall be painted with two coats of oil bound enamel applied to rust and grease free metalwork.

2.28 TESTING ON SITE

The 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 Regulations for the electrical equipment of buildings issued by the I.E.E of Great Britain, the Government Electrical Specification and the Electric Supply Company's By-Laws.

(a) Tests shall be carried out to prove that all 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. Tests shall be carried out to verify the continuity of all conductors of each 'ring' circuit.

(c) Phase tests shall be carried out on completion of the installation to ensure that correct phase sequence is maintained throughout the installation. Triplicate copies of the results of the above tests shall be provided within 14 days of the witnessed tests and the Sub-contractor will be

required to issue to the service engineer the requisite certificate upon completion as required by the regulations referred to above.

(d) Any faults, defects or omissions or faulty workmanship, incorrectly positioned or installed parts of the installation made apparently by such inspections or tests shall be rectified by the Sub-contractor at his own expense.

(e) The Sub-contractor shall provide accurate instruments and apparatus and all labour required to carry out the above tests. The instruments and apparatus shall be made available to the services engineer to enable him to carry out such tests as he may require.

The Sub-contractor shall generally attend on other contractors employed on the project and carry out such electrical tests as may be necessary.

The Sub-contractor shall test to the services engineer's approval and as specified elsewhere in this specification or in standards and regulations already referred to, all equipment, plant and apparatus forming part of the works and before connecting to any power or other supply and setting to work.

Where such equipment, etc., forms part of or is connected to a system whether primarily or of an electrical nature or otherwise (e.g. air conditioning system) the Sub-contractor shall attend on and assist in balancing, regulating testing and commissioning, or if primarily an electrical or other system forming part of works, shall balance, regulate, test and commission the system to the service engineer's approval.

PART B: PARTICULAR SPECIFICATION OF MATERIALS AND WORKS

1.0 CABLES & CABLING STANDARDS

1.1 ANS/TIA/EIA – 568 – A and ISO/IEC 11801

The latest editions of the ANS/TIA/EIA-568-A (568-A) AND ISO/IEC 11801 (‘11801) cabling standards were both published in 1995. The following overview provides some of the requirements and recommendations of each standard including differences between them.

1.2 ANS/TIA/EIA – 568 – A

Commercial Building Telecommunications Cabling Standard.
The Telecommunications Industry Association (TIA) TR42.1 (formerly TR41.8.1) working Group on telecommunications cabling published the ANSI/TIA/EIA-568-A standard in 1995.

1.3 ISO/IEC 11801

Information Technology – Generic Cabling for Customer Premises.
The International Organization for Standardization (ISO) SC 25/WG 3 Working Group on telecommunications cabling published the ISO/IEC 11801 standard in 1995.
Following are highlights of the ‘568-A standard and related Telecommunication Systems Bulletins (TSBs) with notes on differences in terminology and technical requirements with respect to ‘11801. For clarity and consistency, ‘568-A based terminology is used in the following overview.

Purpose

- To specify a generic voice and data telecommunications cabling system that will support a multi-product, multi-vendor environment.
- To provide direction for the design of telecommunications equipment and cabling products intended to serve commercial enterprises.
- To enable the planning and installation of a structured cabling system for commercial buildings that is capable of supporting the diverse telecommunications needs of building occupants.
- To establish performance and technical criteria for various types of cable and connecting hardware and for cabling system design and installation.
- Scope
- Specifications are intended for telecommunications installations.
- Requirements are for structured cabling system with a usable life in excess of 10 years.
- Specifications addressed: -
- Recognized Media
- Cable and connecting Hardware Performance
- Topology
- Cabling Distance
- Installation Practices
- User Interfaces
- Channel Performance

Cabling Elements

- Horizontal cabling
- Horizontal Cross-connect (HC)
- Horizontal Cable
- Transition Point (optional)
- Consolidation Point (optional)
- Telecommunications-Outlet/Connector (TO)
- Backbone Cabling
- Main Cross-connect (MC)

- Interbuilding Backbone Cable
- Intermediate Cross-connect (IC)
- Intrabuilding Backbone Cable
- Work Area (WA)
- Telecommunication Closet (TC)
- Equipment Room (ER)
- Entrance Facility (EF)
- Administration

2.0 HORIZONTAL CABLING SYSTEM STRUCTURE

The horizontal cabling system extends from the telecommunications outlet in the work area to the horizontal cross-connect in the telecommunications closet. It includes the telecommunications outlet, an optional consolidation points or transition point connector, horizontal cable, and the mechanical terminations and patch cords (or jumpers) that comprise the horizontal cross-connect.

2.1 Some points specified for the horizontal cabling subsystem include:

- Recognized Horizontal Cables:

4 pair 100 unshielded twisted-pair.
2-fiber (duplex) 62.5/125 □m or multimode optical fiber 9note: 50/125 m multimode fiber will be allowed in '568-B)

- A minimum of two telecommunications outlets are required for each individual work area. First outlet: 100 twisted pair (category 6A is recommended) Second outlet: 100 □ twisted pair. Two-fiber multimode optical fiber either 62.5/125 □m or 50/125 □m.
- One transition point (TP) is allowed between different forms of the same cable type (i.e. where under carpet cable connects to round cable)
- 50 coax and 150 □ STP-A cabling is not recommended for new installations.

- Additional outlets may be provided. These outlets are in addition to and may not replace the minimum requirements of the standard.
- Bridged taps and splices are not allowed for copper-based horizontal cabling. (Splices are allowed for fiber).
- Application specific components shall not be installed as part of the horizontal cross- connect (e.g., Splitters, baluns).
- The proximity of horizontal cabling to sources of electromagnetic interference (EM) shall be taken into account.

3.0 BACKBONE CABLING SYSTEM STRUCTURE

The backbone cabling system provides interconnections between telecommunications closets, equipment rooms, and entrance facilities. It includes backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to- backbone cross-connections. The backbone also extends between buildings in a campus environment.

- Equipment connections to backbone cabling should be made with cable lengths of 50m (98 ft) or less.
- The backbone cabling shall be configured in a star topology. Each horizontal cross- connect is connected directly to a main cross-connect or to an intermediate cross- connect, then to a main cross connect.
- The backbone is limited to no more than two hierarchical levels of cross-connects (main and intermediate). No more than one cross-connect may exist between a main and a horizontal cross connects may exist between any two-horizontal cross-connects.
- A total maximum backbone distance of 90m (295 ft.) is specified for high band-width capability over copper. This distance is for uninterrupted backbone runs. (No intermediate cross-connect).
- The distance between the terminations in the entrance facility and the main cross- connect shall be documented and should be made available to the service provider.
- Recognized media may be used individually or in combination, as required by the installation. Quantity of pairs and fibers needed in individual backbone runs depends on the area served.

Recognized backbone cables are: 100 □ UTP 150 □ STP-a 625/125□ Multimode Optical Fiber Single Mode Optical Fiber

- Multipair cable is allowed, provided that it satisfies the power sum crosstalk requirements.
- The proximity of backbone cabling to sources of electromagnetic interference (EMI) shall be taken into account.
- Cross-connects for different cable types must be located in the same facilities.
- Bridged taps are not allowed.

3.1 WORK AREA:

The telecommunications outlet serves as the work area interface to the cabling system. Work area equipment and cables used to connect to the telecommunications outlet are outside the scope of '568-A and '11801, but are expected to be specified in the next edition of these standards.

4.0 OPEN OFFICE CABLING

Additional specifications for horizontal cabling in areas with moveable furniture and partitions have been introduced in TIA/EIA TSB75. Horizontal cabling methodologies are specified for "open-office" environments by means of multi-user telecommunications outlet assemblies and consolidation points. These methodologies are intended to provide increased flexibility and economy for installation with open office work spaces that require frequent configuration.

HORIZONTAL DISTANCES OF COPPER LINKS
Copper work area cables connected to a MuTOA, shall meet the requirements of '568-A (sec. 10.5 and 11.5). The maximum length of copper work area cables shall be determined according to:

$C = (102 – H)/12$ $W = C – 7$ (<29m)

Where:
C is the combined length of the work area cable, equipment Cable, and patch cord (m).
W is the length of the work area cable (m).
H is the length of the horizontal cable (m)

The above equations assume that there is a total of 7m (23 ft.) of patch and equipment cables in the telecommunications closet. Table 1 shows the application of these formulae. The length of work area cables shall not exceed 20m (66 ft). The MuTOA shall be marked with the maximum allowable work area cable length.

Length of horizontal cable Maximum length of Work area cable Maximum combined length of the work area cables, patch cords and equipment
Cable

H (m / ft)	W (m / ft)	C (m / ft)
90 (295)	3 (10)	10 (33)
85 (279)	7 (23)	14 (46)
80 (262)	11 (36)	18 (59)
75 (246)	15 (49)	22 (72)
70 (230)	20 (66)	27 (89)

Table 1 – Maximum Length of Work Area Cables

For optical fiber cables, any length combination or length of the horizontal channel does not exceed 100m (328 ft). When deploying a centralized fiber cabling topology, the general guidelines of TSB72 shall be followed.

TELECOMMUNICATIONS CLOSET

Telecommunications closets are generally considered to be floor serving facilities for horizontal cable distribution. They may also be used for intermediate and main cross-connects.

Some specifications related to the telecommunications closet:

- Closets shall be designed and equipped in accordance with ANSI/TIA/EIA-569-A.
- Cable stress from tight bends, cable ties, staples, and tension should be avoided by well- designed cable management.
- Only standards-compliant connecting hardware shall be used.
- Cables and cords used for active equipment connections are outside the scope of the standard (10m total allowed for patch cords, equipment cables, and work area cables for each link).
- Application-specific electrical components shall not be installed as part of the horizontal cabling.
- Horizontal cable terminations shall not be used to administer cabling system changes. Instead, jumpers patch cords, or equipment cords are required for re-configuring cabling connections

The two types of schemes used to connect cabling subsystems to each other and to equipment are known as interconnections and cross-connections.

DEFINITIONS:

Cross-Connection:
A connection scheme using patch cords or jumpers that attach to connecting hardware on each end.
Interconnection:
A connection scheme that provides for direct connections to building cabling from equipment without a patch cord.

7.0 TWISTED PAIR (BALANCED) CABLING

The six categories of transmission performance specified for cables, connecting hardware and links are
Designation Transmission Characteristics Description

i. Transmission characteristics are specified up to 16 MHz Meets applicable category 3 and Class C requirements of ISO/IEC 11801 (including amendments A.1 & A.2), ANSI/TIA/EIA-568-A (including addenda A-1, A-2, & A.3) and TSB67. Requirements are specified to an upper frequency limit of 16MHz.
ii. Transmission characteristics are specified up to 20 MHz Meets applicable category 4 requirements of ISO/IEC 11801 (including amendments A.1 & A.2), ANSI/TIA/EIA-568-A (including addenda A-1, A-2 & A-3) and TSB67.Requirements are specified to an upper frequency limit of 20
MHz This classification is a superset of 3
iii. Transmission characteristics are specified up to 100 MHz Meets applicable Category 5 and class D requirements of ISO/IEC 11801 (including addenda A-1, A-2 & A-3), TSB67 and draft TSB95. Requirements are specified to an upper frequency limit of 100 MHz This classification is a superset of 4.
iv. Transmission characteristics Will be specified up to 250 MHz Performs to category 6 and class E requirements under development by ISO/IEC and TIA Requirements are expected to be specified to an upper frequency limit of at least 250 MHz This classification is a superset
of 6e
v. Transmission characteristics will Be specified up to 600 MHz Performs to category 7 and class F requirements under development by ISO/IEC. Requirements are expected to be specified to an upper frequency limit of at least 600 MHz This classification is an electrical superset of 6.

8.0 UTP TELECOMMUNICATIONS OUTLET/CONNECTOR

- 8-position modular jack per IEC 60603-7 (.568-A states that all pairs must be connected).
- Pin/pair assignment: T568A Optional assignment to accommodate certain systems: T568B.
- Durability rating 750 mating cycle's minimum.

- Backward compatibility and interoperability are required.

9.0 FULLY SHIELDED TELECOMMUNICATIONS OUTLET/CONNECTOR

- Entirely new interface design to support class F cabling.
- Will require a new wiring pin/pair assignment.
- Transmission measurement methods for category 7 are under study.
- Durability rating 1000 mating cycles minimum.

10.0 UTP CONNECTING HARDWARE VS. CABLE NEXT PERFORMANCE

- Specifications cover all types of connectors used in the cabling system including the telecommunications outlet/connector.
- Does not cover work area adapters, baluns, protection, MAUs, filters, or other application-specific devices.
- Temperature range -10°C (14°F) to 60°C (140°F).
- Outlets shall be securely mounted. Outlet boxes with unterminated cables must be covered and marked.
- Transmission requirements are much more severe than cable of a corresponding category.
- Performance markings should be provided to show the applicable transmission category and should be visible during installation (for example 5e) in addition to safety markings.
- Installed connectors shall be protected from physical damage and moisture.

10.1 UTP LINK PERFORMANCE MARKING AND IDENTIFICATION

- Link category marking should be clearly visible on both ends (component markings are not sufficient).
- Labelling, markings, and color-coding shall be provided in accordance with ANSI/TIA/EIA-606.

11.0 SCREENED CABLING (Scope)

As a result of the release of TIA/EIA/IS-729 and the maturity of the '568-A and '11801 standards, telecommunications groups recognize the presence of an overall shield over four twisted-pairs; a media hybrid termed Screened Twisted-Pair or Scope cabling.

11.1 Color-coding

Pair 1 = White/Blue-Blue
Pair 2 = White/Orange-Orange Pair 3 = White/Green-Green.
Pair 4 = White/Brown-Brown

- 0.51mm (24 AWG) 100 Ω 4-pair enclosed by a foil shield.
- A copper conductor drain wire of .040mm (26 AWG) or larger shall be provided.
- Should be marked "100 Ω ScTP", in addition to any safety markings required by local or national codes.

- Same mechanical and transmission requirements apply to backbone and horizontal cables.
- Additional performance requirements, including surface transfer impedance, is specified in the IS-729 standard entitled, "Technical Specifications for 100 Ω Screened Twisted-Pair cabling".

11.2 ScTP Connectors:

- Interface and pair assignments same as IEC 60603-7 ('568-A states that all 4 pairs must be connected).
- Additional transfer impedance and shield mating interface requirements specified in the IS-729 standard entitled, "Technical Specifications for 100 Ω Screened Twisted-pair Cabling".

11.3 ScTP Patch Cords:

- Specifications call for 26 AWG (7 strands @ 0.15mm) or 24 AWG (7 strands @ 0.20mm) stranded conductors.
- Allows for an overall shield.
- Less severe attenuation than horizontal cable.

11.4 ScTP Installation Practices:

- Shield shall be bonded at both ends at the "Telecommunication Grounding Busbar".
- The difference between the two grounds shall be no more than 1.0 V RMS.

12.0 FULLY SHIELDED CABLING (SSTP)

12.1 Fully Shielded Cable:

- Color-coding:
  Pair 1 = White/Blue-Blue
  Pair 2 = White/Orange-Orange Pair 3 = White/Green-Green Pair 4 = White/Brown-Brown
- Four 0.51mm (24 AWG) or larger 100 Ω twisted-pairs each enclosed by an individual foil shield with an overall shield provided over the four-pairs.
- Mechanical and transmission requirements are under development by ISO.

12.2 Fully Shielded Connectors:

- Interface and pair assignments are under development by ISO and will be entirely different from the T568A and T568B assignments.
- Mechanical and transmission requirements are under development by ISO.

12.3 Fully Shielded Patch Cables.

- Mechanical and transmission requirements are under development by ISO.

12.4 Fully Shielded Installation Practices:

- Installation Practices are under development by ISO

12.5 TSB67

Transmission Performance Specifications for Field Testing of UTP Cabling Systems
This bulletin provides users with the opportunity to use comprehensive test methods to validate the transmission performance characteristics of installed category 5 and lower grade UTP cabling systems. The categories of UTP cabling systems in this bulletin also correspond with the UTP cabling categories of ANSI/TIA/EIA-568-A.Additional transmission performance and applicable field test requirements are referenced in TSB95, '568-A-5 and amendment 2 to '11801 (FDAM 2)

12.6 Some points specified for TSB67 transmission field testing for UTP Cabling Systems

- UTP cabling systems are comprised of cables and connecting hardware specified in TIA/EIA-568- A.
- Required test parameters include wire-map, length, attenuation, and crosstalk.
- Two levels of pass or fail are indicated, depending on measured margin compared to minimum specifications. Testing of NEXT loss is required in both directions.
- Level II equipment meets the most stringent requirements for TSB67 measurement accuracy. Level II equipment will be required to verify category 5e and FDAM 2 performance.
- Requirements are intended for performance validation and are provided in addition to '568-A requirements on components and installation practices.

13.0 OPTICAL FIBRE CABLING

The current '568-A specification on optical fiber cabling consists of one recognized cable type for horizontal subsystems and two cable types for backbone subsystems:
Horizontal – 62.5/125 μm multimode (two fibers per outlet). Backbone - 62.5/125 μm multimode or single mode.

'568-B will allow the use of 50/125 μm multimode optical fiber in both the horizontal and backbone in addition to the types listed above.
All optical fiber components and installed practices shall meet applicable building and safety codes

13.1 Optical Fiber Patch Cords:

- Shall be a two-fiber (duplex) indoor cable of the same type as the cables to which they connect.
- Shall allow for easy connection and reconnection and ensure that polarity is maintained (568SC) configuration required).
- Shall perform a pair-wise cross-over of fiber positions A and B. (If provided in simplex form, one connector shall be identified as "A" and the other "B".)

13.2 Installation of Optical Fiber Connecting Hardware:

- Connectors shall be protected from physical damage and moisture.
- Capacity for 12 or more fibers per rack space [44.5mm (1.75 in.)] should be provided.
- Optical fiber connecting hardware shall be installed: - To provide well organized installation with cable management. - In accordance with manufacturer's guidelines.

13.3 Optical Fiber Cabling Installation:

- A minimum of 1m (3.28 ft.) of two-fiber cable (or two buffered fibers) shall be accessible for termination purposes.
- Testing is recommended to assure correct polarity and acceptable link performance. Informative Annex H of '568-A is provided for recommended optical fiber link performance testing criteria.

13.4 Optical Fiber Work Area Connector:

- A simplex or duplex SC connector shall be used at the work area.
- Recommended adapter and connector are the 586SC (a duplex SC that is capable of simplex operation).

13.5 Optical Fiber Connections:

- Connector designs shall meet the requirements of the corresponding TIA FOCIS documents.
- Telecommunications outlet/connector boxes shall be securely mounted at planned locations.
- The telecommunications outlet/connector box shall have:
  - The ability to secure optical fibers.
  - Cable management means to assure a minimum bend radius of 25mm (1.00 in.) and should have slack storage capability.
  - Provisions for terminating a minimum of two optical fibers into a 568SC adapter.
- Identification of fiber types:
  - Multimode connectors and adapters shall be identified with the color beige.
  - Single mode connectors and adapters shall be identified with the color blue.
- The two positions in a duplex connector are referred to as "position A" and "position B".
- The 568SC adapter performs a pair-wise cross-over between position A and position B of two mated connectors.
- Optical fiber runs intended for future connections shall be stored in a telecommunications outlet/connector box.

13.6 Small Form Factor (SFF) Connectors:

- Qualified SFF duplex and multi-fiber connector designs may be used in the main cross connect, intermediate cross-connect, horizontal cross-connect, and consolidation points.
- A TIA Fiber Optic Connect Intermate ability Standard (FOCIS) shall describe each SFF design.

- The SFF design shall satisfy the requirements specified in Annex A of the proposed '568-B.3 standard.
- Some advantages of SFF connectors include compact size, modular compatibility with the eight-position modular copper interface, and adaptability to high-density network electronics.

13.7 TSB72 Centralized Optical Fiber Cabling Guidelines

This Telecommunications Systems Bulletin (TSB) provides the user with the flexibility of designing an optical fiber cabling system for centralized electronics typically in single tenant buildings. It contains information and guidelines for centralized optical fiber cabling.

Some points specified in TSB-72 for a centralized optical fiber cabling system include:

- Intended for single-tenant users who desire centralized vs. distributed electronics.
- Implementation allows cables to be spliced or interconnected at the telecommunications closet such that cables can be routed to a centralized distributor for total cable lengths of 300m (984 ft.) or less, including patch cords or jumpers.

- Allows for migration from an interconnection or splice to a cross-connection scheme that can also support distributed electronics.
- Pull-through implementations are allowed when total length between the tele- communications outlet/connector and centralized cross-connect and centralized cross- connect is 90m (295 ft.) or less.
- Connecting hardware required to:

 join fibers by re-mate able connectors or splices,
 connectors shall be 568SC interface,
 provide for simplex or duplex connection of optical fibers,
 provide means of circuit identification,
 allow for addition and removal of optical fibers.

Note: Some multi-mode fiber implementations may be limited to an operating range of 220m to support 1000BASE-SX.

13.8 TIA/EIA-568-A-1

Propagation Delay and delay Skew
This addendum to '568-A describes propagation delay and delay skew requirements for all '568-A compliant 4-pair 100 cables. Propagation delay and delay skew requirements of multipair cables are subject to additional study.

Propagation delay is equivalent to the amount of time that passes between when a signal is transmitted and when it is received at the other end of a cabling channel. Delay skew is the difference between the pair with the least delay and the pair with the most delay. Transmission errors that are associated with excessive delay and the delay skew include increased jitter and bit error rates.

The maximum propagation delay skew requirement for 4-pair 100 cables is frequency dependent and is specified by the following equation:

Delay (ns/100m) 534 + 36/ *f*MHz
Cable delay skew shall not exceed 45 ns/100m between 1 MHz and the highest referenced frequency for a given category.

It is anticipated that the requirements of '568-A-1 will also be applicable to pending category 6 cable propagation delay and delay skew specifications while more stringent performance criteria will be specified for pending category 7 cables.

13.9 TIA/EIA-568-A-2

i. Corrections and additions to TIA/EIA-568-A
ii. This addendum to '568-A provides modifications and corrections to the content of '568-A as a result of advances in telecommunications research and development. Revisions are as follows:
iii. Centralized optical fiber cabling is referenced in two locations (5.2.1 and 7.4.1) as an alternative to the optical cross-connection located in the telecommunications closet when deploying 62.5/125 m optical fiber cable in the horizontal. TIA/EIA TSB72 Centralized Optical Fiber Cabling Guidelines are also referenced.
    a. The ANSI/ICEA reference in section 10.2.3 was updated to ANSI/ICEA S-90-661-1994 for specifying the physical and mechanical requirements of '568-A recognized cables.
    b. Additional text was incorporated into section 10.4.3.4 specifying that the connecting hardware used for 100 UTP cabling shall not result in or contain any transposed (e.g., transposition of pairs
iv. 2 or 3) or reversed (also called tip/ring reversals) pairs. It is further noted that applications requiring transposed or reversed pairs shall utilize adapters, work area or equipment cords to swap pairs.
    a. A reference to the TSB67 field test methodologies is added to section 10.6.4
    b. The 568SC optical fiber connector axial pulls off strength requirement was decreased from 22 N (5 lbf) to 19.4 N (4.4 lbf)
    c. Globally, the word "polarization" was replaced with "polarity".

d. The initial contact resistance specified in Annex A for connecting hardware was increased from 1 m□ to 2.5 m□ and the contact resistance measurement method was re-written to be more user- friendly.
e. A provision for common mode terminations for testing connecting hardware NEXT loss and return loss was incorporated into Annex B. This revision accommodates telecommunications networking implementations that may employ common mode terminations in the active equipment.

13.10 TIA/EIA-568-A-3
Addendum 3 to TIA/EIS-568-A

As a result of the demand for open office architecture and the need to support multiple telecommunications applications in a shared sheath, this addendum to '568-A addresses revised performance specifications for hybrid cables. '568-A-3 also introduces a new term called "bundled cables" to describe 4-pair cable assemblies that are not covered by an overall sheath (as specified for hybrid cables), but by any generic binding method such as "speed-wrap" or "cable-ties"

The new hybrid and bundled cable requirements state that power sum NEXT loss between all non- fiber cable types within that cable shall be 3 dB better than the specified pair-to-pair NEXT loss for each cable type.

13.11 TIA/EIA-568-A-4
Production Modular Cord NEXT Loss Test Method and Requirements for Unshielded Twisted-Pair Cabling

TIA/EIA-568-A-4 defines a generic and non-destructive methodology for NEXT loss testing of modular plug cords. NEXT loss performance requirements for category 5 modular plug cords, when measured with the particular test head specified in the Standard, are provided. Note that, although the methodology may be used as the basis for determining the minimum NEXT loss performance requirements of other categories of modular plug cords, at present, the Standard does not define a test head or specific test limits for category 5e or category 6 patch cords. The methodology described in the Standard contains the detailed NEXT loss calculations (which are based upon patch cable NEXT loss, test head NEXT loss, and cable and connector attenuation contributions) for the determination of the NEXT loss limits for any category patch cord and suitably designed teat head.

13.12 TIA/EIA-568-A-5
Transmission Performance Specifications for 4-pair 100ς Enhanced Category 5 Cabling.

'568-A-5 specifies enhanced category 5 (category 5e) performance requirements. These requirements are recommended for new category 5 cabling installations and are expected to become the de facto minimum standard for category 5 cabling. This document addresses the minimum equal level far-end crosstalk (ELFEXT) and return loss requirements necessary to support developments in applications technology and defines the minimum performance needed for a worst case for-connector channel to support applications that utilize full-duplex transmission schemes, such as Gigabit Ethernet. To ensure additional crosstalk headroom for robust applications support, this document also specifies power sum performance requirements for category 5e cables and cabling.

Addendum 'A-5 is a normative document and, unlike TSB95, it provides mandatory requirements, not recommendations.

13.13 TIA/EIA TSB95
Additional Transmission Performance Guidelines for 100ς 4-pair Category 5 Cabling.

TSB95 outlines minimum recommendations for the new channel parameters of return loss and equal level far-end crosstalk (ELFEXT). These return losses and ELFEXT recommendations are specified to ensure the support of Gigabit Ethernet over installed or "legacy" category 5 cabling and were derived from worst case performances of channels with only two connection points. The two- connector channel topology is consistent with the IEEE committee's assumption that cabling used to support Gigabit Ethernet systems will

most likely utilize an interconnect instead of a cross-connect field and will not include a consolidation or transition point connection. Existing installed category 5 cabling should be verified to ensure that performance meets the minimum recommendations of this document. Channel configurations with three or four connectors that meet the specified ELFEXT and return loss recommendations will also support Gigabit Ethernet. Because the specifications of this document are applicable for the qualification of existing, installed cabling only, they are not recommended to be used as the minimum performance criteria for new category 5 cabling.

13.14 TIA/EIA/IS-729
Technical Specifications for 100ς Screened Twisted-Pair Cabling.

IS-729 is an interim standard that supplements TIA-568-A and ISO/IES 11801 screened twisted-pair cabling specifications by describing additional technical requirements on the outlet interface, shield effectiveness, installation practices, and performance relative to ScTP links and components.

13.15 ISO/IEC 11801:1995 FDAM 2 Draft Amendment 2 to ISO/IEC 11801

The performance specifications in ISO amendment 2 provide new requirements for return loss and ELFEXT loss to complement the existing ISO class D requirements. The new specified return loss and ELFEXT loss requirements are in harmony with the values proposed in '568-A-5, however, the document does not specify additional NEXT loss margin over and above the existing class D requirements. FDAM 2 also includes propagation delay and delay skew requirements for channels and permanent links that are in harmony with the requirements of TIA/EIA-568-A-1

The requirements of amendment 2 to ISO/IES 11801 are normative and this document will become the governing international standard for new class D cabling installations.

14.0 CABLING SPECIFICATION CROSS-REFERENCE CHART (ANSI/TIA/EIA-568-A AND ISO/IEC 11801)

The following chart provides a side-by-side comparison that highlights many of the fundamental similarities and differences between ANSI/TIA/EIA-568-A and ISO/IEC 11801.

14.1 HORIZONTAL UTP CABLE

- Solid 4-pair 0.51mm (24 AWG) specified (0.64mm (22 AWG) solid also allowed). An overall shield ((ScTP) is optional.
    - Performance marking should be provided to show the applicable performance category. These markings do not replace safety markings.
    - Colour-coding:

White/blue-blue White/orange-orange White/green-green White/brown-brown.

14.2 HYBRID AND BUNDLED CABLES
Hybrid/Bundled cables:

- Hybrid/bundled cables that contain multiple units of recognized horizontal copper cables are subject to additional NEXT loss requirements between cable units. These requirements assure a minimum of 3 dB additional power sum crosstalk isolation between applications that may operate on adjacent binder groups.
- All detailed specifications for the individual cable units used in the hybrid assembly still apply.
- Hybrid bundled cables shall meet the transmission requirements specified in TIA/EIA-568-A-3.

14.3 UTP PATCH CORDS AND CROSS-CONNECT JUMPERS.

- Patch cords must use stranded cable for adequate flex life
- Standard cables must meet the minimum performance requirements for horizontal cable except that 20 percent more attenuation is allowed by '568-A and 50 percent more attenuation is allowed by '11801.

- Color-code for cross-connect jumpers: One conductor white, the other a visibly distinct color such as red or blue.
- Performance markings should be provided to show the applicable transmission category in addition to safety markings.
- Insulated O.D of stranded wires should be 0.8mm (0.032 in.) to 1mm (0.039 in.) to fit into a modular plug.
- Production performance specifications for plug cord assemblies are addressed in '568-A-4
- Color codes for stranded, 100 □ UTP patch cord: Option 1 Option 2

  White/blue-blue PAIR 1 green-red
  White/orange-orange PAIR 2 black-yellow
  White/green-green PAIR 3 blue-orange
  White/brown-brown PAIR 4 brown-slate

Note: Because of their identical pair groupings, patch cords terminated with either T568A or T568B pair assignments may be used interchangeably, provided that both ends are terminated with the same pin/pair scheme.

14.4 BACKBONE UTP CABLE

- Performance markings should be provided to show the applicable performance category. These markings do not replace safety markings.
- Services with incompatible signal levels should be partitioned into separate binder groups. Guidelines for shared sheaths are provided in Annex D of '568-A.
- Transmission requirements are equivalent to horizontal cables except that NEXT loss performance is based on power-sum rather than worst-pair characterization to allow for multiple disturbing signals (of the same type) in the same sheath.
- Note: Tip conductors have colored insulation that corresponds to that of the binder group. Ring conductors have colored insulation that corresponds to that of the pair.
- Backbone UTP cables consist of solid 0.51 mm (24 AWG) cables that contain more than four pairs (typically multiples of 25-pairs are used). An overall shield is optional.
- Color-coding (specified by reference to ICEA)

15.0 MODULAR WIRING REFERENCE Modular Jack Styles:

There are four basic modular jack styles. The 8-position modular outlets are commonly and incorrectly referred to as "RJ45". The 6-position modular jack is commonly referred to as RJ11. Using these terms can sometimes lead to confusion since the RJ designation actually refer to very specific wiring configurations called Universal Service Order Code (USOC). The designation 'RJ' means Registered Jack.
Each of these basic jack styles can be wired for different RJ configurations. For example, the 6-position jack can be4 wired as an RJ11C (1`-pair), RJ14C (2-pair), or RJ25C (3-pair) configuration. An 8-position jack can be wired for configurations such as RJ61C (4-pair) and RJ48C. The keyed 8-position jack can be wired for RJ46S, and RJ47S. The fourth modular jack style is a modified version of the 6-position jack (modified modular jack or MMJ). It was designed to eliminate the possibility of connecting DEC data equipment to voice lines and vice versa.

15.1 MODULAR PLUG PAIR CONFIGURATIONS

It is important that the pairing of wires in the modular plug match the pairs in the modular jack as well as the horizontal and backbone wiring. If they do not, the data being transmitted may be paired with incompatible signals.

Modular cords wired to the T568A color scheme on both ends are compatible with T568B systems and vice versa.

15.2 STRAIGHT THROUGH OR REVERSED?

Modular cords are used for two basic applications. One application uses them for patching between modular patch panels. When used in this manner modular cords should always be wired “straight through” (pin 1 to pin 1, pin 2 to pin 2, pin 3 to pin 3, etc.). The second major application uses modular cords to connect the workstation equipment (PC, phone, FAX etc.) to the modular outlet.
These modular cords may either be wired “straight-through” or “reversed” (pin 1 to pin 6, pin 2 to pin 5, pin 3 to pin 4, etc.) depending on the system manufacturer’s specifications. This “reversed” wiring is typically used for voice systems. The following is a guide to determine what type of modular cord you have.

15.3 HOW TO READ A MODULAR CORD

Align the plugs side-by-side with the contacts facing you and compare the wire colors from left to right. If the colors appear in the same order on both plugs, the cord is wired “straight-through”. If the colors appear reversed on the second plug (from right to left), the cord is wired “reversed”.

15.4 COMMON OUTLET CONFIGURATIONS
Two wiring schemes have been adopted by the ‘568-A and ‘11801 standards. They are nearly identical except that pairs two and three are reversed. T568A is the preferred scheme because it is compatible with 1 or 2-pair USOC systems. Either configuration can be used for Integrated Services Digital Network (ISDN) and high-speed data applications. Transmission categories 3, 4, 5, 5e, and 6 are only applicable to this type of pair grouping.

USOC wiring is available for 1-, 2-, 3-, or 4-pair systems. Pair 1 occupies the center conductors, pair 2 occupies the next two contacts out, etc. One advantage to this scheme is that a 6-position plug configured with 1, 2, or 3 pairs can be inserted into an 8-position jack and still maintain pair continuity. A note of warning though, pins 1 and 8 on the jack may become damaged from this practice. A disadvantage is the poor transmission performance associated with this type of pair sequence. None of these pair schemes is cabling standard compliant.
10Base-T wiring specifies an 8-position jack but uses only two pairs. These are pairs two and three of T568A and T568B schemes.

The MMJ is a unique wiring scheme for DEC® equipment.

16.0 RECOMMENDED CABLING PRACTICES
Do’s
- Terminate each horizontal cable on a dedicated telecommunications outlet.
- Locate the main cross-connect near the center of the building to limit cable distances.
- Maintain the twist of horizontal and backbone cable pairs up to the point of termination.
- Tie and dress horizontal cables neatly and with a minimum bend radius of 4 times the cable diameter.

Don’ts
- Do not use connecting hardware that is of a lower category than the cable being used.
- Do not create multiple appearances of the same cable at several distribution points (called bridged taps)
- Do not over-tighten cable ties, use staples, or make sharp bends with cables.
- Do not place cable near equipment that may generate high levels of electromagnetic interference.

17.0 UTP CONNECTOR TERMINATIONS

- Pair twists shall be maintained as close as possible to the point of termination.
- Untwisting shall not exceed 25mm (1.0 in) for category 4 links and 13mm (0.5 in) for category 5, category 5e, and category 6 links. Follow manufacturer guidelines for category 3 products, if no guidelines exist, then untwisting shall not exceed 75mm (3.0 in).

- Connecting hardware shall be installed to provide well-organized installation with cable management and in accordance with manufacturer's guidelines.
- Strip back only as much jacket as is required to terminate individual pairs.

17.1 UTP CABLING INSTALLATION PRACTICES.

- To avoid stretching, pulling tension should not exceed 110N (25 lbf) for 4-pair cables.
- Installed bend radii shall not exceed:
  - 4 times the cable diameter for horizontal UTP cables.
  - 10 times the cable diameter for multi-pair backbone UTP cables.
- Horizontal cables should be used with connecting hardware and patch cords (or jumpers) of the same performance category or higher
- Avoid cable stress, as caused by:
  - cable twist during pulling or installation
  - tension in suspended cable runs
  - tightly cinched cable ties or staples
  - tight bend radii.
- Important Note: Installed UTP cabling shall be classified by the least performing component in the link.

18.0 ANSI/TIA/EIA-569-A

Commercial Building Standard for Telecommunications Pathways and Spaces.

The TIA TR42.3 (formerly TR41.8.3) Working group on Telecommunications Pathways & Spaces published the ANSI/TIA/EIA-569-A ('569-A) Standard in 1998. Following are highlights of the '569-A Standard:

Purpose

- Standardize design and construction practices.
- Provides a telecommunications support system that is adaptable to change during the life of the facility. Scope
- Pathways and spaces in which telecommunications media are placed and terminated.
- Telecommunications pathways and spaces within and between buildings.
- Commercial building design for both single and multi-tenant buildings. Elements
- Horizontal
- Backbone
- Work Area
- Telecommunications Closet
- Equipment Room
- Main Terminal Space.
- Entrance Facility

18.1 HORIZONTAL

Pathways from telecommunications closet to work area.

Includes:
Pathway Types:
- Underfloor-Network of raceways embedded in concrete consisting of distribution and header ducts, trenches, and cellular systems.
- Access Floor-Raised modular floor tile supported by pedestals, with or without lateral bracing or stringers.
- Conduit-Metallic and nonmetallic tubing of rigid or flexible construction permitted by applicable electrical code.
- Tray & Wireway-Prefabricated rigid structures for pulling or placing cable.

- Ceiling-Open environment above accessible ceiling tiles and frame work.
- Perimeter-Surface, recessed, molding, and multichannel raceway systems for wall mounting around rooms or along hallways.

Space Types:

- Pull Boxes-Used in conjunction with conduit pathway systems to assist in the fishing and pulling of cable.
- Splice Boxes-a box, located in a pathway run, intended to hold a cable splice.
- Outlet Boxes-Device for mounting faceplates, housing terminated outlet/connectors, or transition devices.

Design Considerations:

- Grounded per code and ANSI/TIA/EIA-607 (‘607)
- Designed to handle recognized media as specified in ANSI/TIA/EIA-568-A (‘568-A)
- Not allowed in elevator shafts.
- Accommodate seismic zone requirements
- Installed in dry locations

18.2 BACKBONE

Pathways routed from closet-to-closet.

Building Backbone Types:

- Ceiling
- Conduit
- Sleeves-An opening, usually circular, through the wall, ceiling, or floor.
- Trays

Typically, the most convenient and cost-effective backbone pathway design in multi-story buildings, is to have stacked closets located one above the other, connected by sleeves or slots.

Design Considerations:

- Grounded per code and ‘607
- Accommodate seismic zone requirements
- Water should not penetrate the pathway system
- Tray, conduits, sleeves, slots penetrate closets minimum 25mm (1 in.)
- Designed to handle all recognized media (as specified in ‘568-A)
- Integrity of all fire stop assemblies shall be maintained.

18.3 WORK AREA

Primary location where the building occupants interact with dedicated telecommunications equipment.

Design Considerations:

- At least one telecommunication outlet box location shall be planned for each work area.
- This location should be coordinated with the furniture plan. A power outlet should be nearby.
- Control center, attendant, and reception areas shall have direct and independent pathways to the serving telecommunications closet.
- Furniture System design:
  - Cable access via walls, columns, ceilings, or floors. Fittings that transition between building and furniture pathways require special planning.
  - Furniture pathway fill capacity is effectively reduced by furniture corners, and connectors mounted within the furniture pathway systems.
  - Furniture pathways bend radius shall not force the installed cable to a bend radius of less than 25 mm (1 in.)
  - Furniture spaces designed to house slack storage, consolidation points, or multi- user telecommunications outlet assemblies shall provide space for strain relieving, terminating, and
  - Slack storage and furniture pathway fill, shall not affect the bend radius and termination of the cable to the connector.
  - Furniture pathway openings shall comply with either of two sizes:
    - Standard NEMA opening (NEMA OS 1 (Ref D. 14), WD-6 (Ref D. 15))
    - Alternate opening

Power/telecommunication separation requirements is governed by applicable electrical code for safety. Minimum separation requirements of Article 800-52 of ANS/NFPA 70 (National Electric Code) shall be applied.

18.4 TELECOMMUNICATIONS CLOSETS

Recognized location of the common access point for backbone and horizontal pathways.
Design:

- Dedicated to telecommunications function.
- Equipment not related to telecommunications shall not be installed, pass through or enter the telecommunications closet.
- Multiple closets on the same floor shall be interconnected by a minimum of one (78 (3) trade size) conduit, or equivalent pathway.
- Minimum floor loading 2.4 kappa (50 lbf/ft2).

Design Considerations:

- Minimum one closet per floor to house telecommunications equipment/cable terminations and associated cross-connect cable and wire.
- Located near the center of the area being served.
- Horizontal pathways shall terminate in the telecommunications closet on the same floor as the area served.
- Accommodate seismic zone requirements.
- Two walls should have 20mm (0.75 in.) A-C plywood 2.4m (8ft.) high.
- Lighting shall be a minimum of 500 lx (50-foot candles) and mounted 2.6m (8.5 ft.) above floor.
- False ceilings shall not be provided.
- Minimum door size 910mm (36 in.) wide and 2000mm (80 in.) high without sill, hinged to open outwards, or slide-to-slide or removable, and fitted with a lock.
- Minimum of two dedicated 120V 20A nominal, non-switched, AC duplex electrical outlet receptacles, each on separate branch circuits.
- Additional convenience duplex outlets placed at 1.8m (6 ft.) intervals around perimeter, 150mm (6 in.) above floor.
- Access to the telecommunications grounding system as specified by ANSI/TIA/EIA-607.
- HVAC requirements to maintain temperature the same as adjacent office area. A positive pressure shall be maintained with a minimum of one air change per hour or per code.

18.5 EQUIPMENT ROOM

A centralized space for telecommunications equipment that serves specific occupants of the building. Any or all of the functions of a telecommunications closet or entrance facility may alternately be provided by an equipment.

Location

- Site locations should allow for expansion.
- Accessible to the delivery of large equipment.
- Not located below water level.
- Away from sources of EMI
- Safeguards against excessive vibration
- Sizing shall include projected future as well as present requirement.
- Equipment not related to the support of the equipment room shall not be installed in, pass through, or enter the equipment room.

Design Considerations

- Minimum clear height of 2.4m (8 ft.) without obstruction.
- Protected from contaminants and pollutants.
- Access to backbone pathways.
- HVAC provided on a 24 hours-per-day, 365 days-per-year basis.

- Temperature and humidity-controlled range 18° C (64° F) to 24° C (75° F) with 30% to 55% relative humidity measured 1.5m (5 ft.) above floor level.
- Separate power supply circuit shall be provided and terminated in its own electrical panel.
- Minimum lighting 500 ix (50-foot candles). Switch location shall be near entrance door to room.
- Minimum door same as telecommunications closet. Double doors without center post or sill are recommended.
- Access to ground per ANSI/TIA/EIA-607.

18.6 MAIN TERMINAL SPACE

Centralized space that houses the main cross-connect. Commonly used as a separate space in multi-tenant buildings to serve all tenants.

- Location considerations are as specified for equipment room.
- Provisioning area as specified for telecommunications closets except power is reduced to convenience receptacles.

18.7 ENTRANCE FACILITY

Consists of the telecommunications service entrance to the building and backbone pathways between buildings.

Location

- Providers of all telecommunications services shall be contracted to establish requirements.
- Location of other utilities shall be considered in locating the entrance facility.
- Alternate entrance facility should be provided where security, continuity or other special needs exist.
- Equipment not related to the support of the entrance facility should not be installed in, pass through, or enter the telecommunications entrance facility.
- Dry location not subject to flooding and close as practicable to building entrance point and electrical service room.

Design Considerations.

- Accommodate the applicable seismic zone requirements.
- A service entrance pathway shall be provided via one of the following entrance types: Underground, buried, Aerial, Tunnel.
- Minimum one wall should be covered with rigidly fixed 20mm (0.75 in.) A-C plywood.
- Minimum lighting same as telecommunication closet.
- False ceilings shall not be provided.
- Minimum door same as telecommunications closet.
- Electrical power same as telecommunications closet. No convenience receptacles mentioned.
- Grounding same as telecommunications closet.

18.8 MISCELLANEOUS

- Fire stopping per applicable code
- Horizontal pathway separation from Electromagnetic interference (EMI) sources:
  - Separation between telecommunications and power cables (Article 800.52 of ANSI/NFPA 70)
  - Building protected from lighting (ANSI/NFPA 780 (Ref D.4) - Surge protection (Article 280 of ANSI/NFPA 70 and 9.11 of ANS/IEEE 1100 (Ref D.1)
  - Grounding (ANS/TIA/EIA-607)
  - Corrected faulty wiring (Section 7.5 of ANSI/IEEE 1100)
- Reducing noise coupling:
  - Increase separation from noise sources
  - Electrical branch circuit line, neutral, and grounding conductors should be maintained close together.
  - Use of surge protectors in branch circuits
  - Use fully enclosed grounded metallic raceway or locate cabling near grounded metallic surface.

19.0 TIA/EIA-569-A-1 Perimeter Pathway Addendum

This addendum deals with the constriction, applications, premises design and installation of perimeter pathways also known as surface raceway systems.

It describes both single and multi-channel systems mounted on walls s at a variety of heights and directions. The sizing of such pathways is based on 40% fill for initial installations but allows up to 60% fill for moves adds or changes to the installed cabling system during its life cycle. Fitting for perimeter raceway systems must allow for the band radius requirements of the installed cable.

20.0 TIA/EIA-569-A-2

Furniture Pathway Fill Addendum.

The sizing of such pathways is based on 40% fill for initial installations but allows for up to 60% fill for moves, adds and changes to the installed cabling system during its life cycle. Furniture fittings such as outlets and connectors used to terminate the installed cables need to be considered when determining the percentage of fill. Fish and pull techniques may result in reduced capacity of the pathway as compared to furniture manufacturers which allow placing cables into the pathways.

20.1 SP-4198
Revision to subclause 4.3, “Access Floor”, of TIA/EIA-569-A
Introduces low profile floors as compared to standard height floors. Low profile floors are 6” or lower while standard height floors are 6” or greater. This revision describes the use of access floors as it refers to guidelines and installation.

20.2 SP-4517
Addendum 4 to ANSI/TIA/EIA-569-A Poke-Thru Devices
A poke-thru is a device for routing cables through a floor while maintaining the fire-rating integrity of the floor. These devices are an option for routing horizontal cables when other pathway types are not typical. Types include flush floor mount and those that rise up above floor level, also known as pedestal, raised, tombstone or monument

PARTICULAR SPECIFICATIONS FOR CLOSED CIRCUIT COLOUR

TELEVISION SYSTEM

1. **SET UP**

The offered system will cover all entrances and exits (external and floor level), general areas and will give a detailed view of all the targeted areas.
All designated area will be covered by fixed high resolution indoor cameras as well as Outdoor fixed Day/Night cameras and PTZ cameras in order to get a comprehensive view of the activities in the building and around it.
The offered system will allow recording of all cameras at any time at 30 IPS and 4CIF.
The system will allow for at least 1 month storage of the recording from all cameras.

2. **SYSTEM DESIGN**

The offered System will be based on Hybrid DVRs that allow connectivity of cameras through coax as well as IP infrastructure. The offered system will allow viewing of any camera from the control room.
Cameras will be connected using coax/UTP infrastructure.
The offered system should have an open architecture that will allow unlimited expansion for any number of cameras. The offered system will allow for secure mode of communication.
The system will be operated through a central video console station.
The controller will be able to view and control all cameras from one keyboard.

3. **MANDATORY REQUIREMENTS**

A. All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's system.

B. All systems and components shall have been thoroughly tested and proven in actual use.

C. All systems and components shall be provided with the availability of a, 24-hour technical assistance program (TAP) from the manufacturer. The TAP shall allow for immediate technical assistance for either the dealer/installer or the end user at no charge.

D. All systems and components shall be provided with a one-day turn around repair express and 24-hour parts replacement. The repair and parts express shall be guaranteed by the manufacturer on warranty and non-warranty items.

E. The supplier shall be the manufacturer, or the manufacturer appointed agent (proof to be submitted).

F. The Offered system has been installed and commissioned by the supplier in other locations.

G. The proposal will include operators training in Kenya and system manager factory training (at the manufacturer training facility).

4. **DIGITAL VIDEO RECORDER**

A. The digital video recorder shall capture high resolution video at up to 4CIF resolution and shall record up to 30 IPS at 4CIF resolution per channel. The digital video recorder shall allow for programmable recording schedules for each camera.

B. The digital video recorder shall have storage optimization technology to allow for automatic reduction of IPS after a period of time.

C. The digital video recorder shall incorporate motion detection capability, compatible with the Jog/Joystick keyboard for control and operation, and it shall allow the user to configure and program via a USB keyboard. The digital video recorder shall control PTZ cameras from the front panel as well as from the keyboard. The main monitor shall display multiple-screen formats and shall provide for the user interface. Programmable spot monitors shall be available for sequencing all inputs. Users shall be able to use an analog, and/or S-Video, or VGA monitor as a main monitor. The digital video recorder shall use Internet Protocol-based networking to deliver control and monitor of video recorders. All connections shall be made over a secure VPN connection, reducing the risks prevalent with public Internet- based data transfers.

D. The digital video recorder shall include e-mail on alarm, compact flash card operating system drive, programmable scripts, and a simplified icon-based user interface. The digital video recorder shall incorporate a 10/100/1000 Mbps network port.

E. The digital video recorder shall meet or exceed the following design and performance specifications.

ELECTRICAL SPECIFICATION

i)	**ELECTRICAL SPECIFICATIONS**	
A.	Power Input	240 VAC, 50/60 Hz
B.	Power Supply	Internal
C.	Cable Type:	1 USA standard
		1 UK standard (240 VAC, 3 prongs, molded connector)
ii)	**ENVIRONMENTAL SPECIFICATIONS**	
A.	Operating Temperature	10ºC to 35ºC
B.	Operating Humidity:	20% to 80%, non-condensing
iii)	**PHYSICAL SPECIFICATIONS**	
A.	Construction:	Steel cabinet
B.	Mounting:	Desktop (feet) or rack
		2 RU per unit, 1 RU between units
iv)	**MECHANICAL SPECIFICATIONS**	
A	System	
1	Operating System:	Microsoft Windows XP/ VISTA, Linux
2	User Interface:	Semi-transparent on-screen overlays

B.	**Video**		
1	Video Standards		
a.	Input:	NTSC/PAL, composite	
b.	Output:	NTSC/PAL, S-Video, composite VGA (1024 x 768)	
2	Video Decoding:	MPEG-4	
3	Video Resolutions:	NTCS	PAL
a.	4CIF:	704 x 480	704 x 576
b.	2CIF:	704 x 240	704 x 288
c.	CIF:	352 x 240	352 x 288
4	Video Inputs/Connectors:	4/8/16, BNC, looping,75 ohms, 0.5-1 Vp-p	
5	Video Termination:	Hi-Z, 75 ohms, software controlled	
6	Display/Recording Speed:	Up to recording rate	
7	Display Modes:	Single image, 2x2, 3x3, and 4x4	
8	Video Outputs:	1, BNC, NTSC/PAL, 75 ohms, 1 Vp-p	
		1, S-Video, NTSC/PAL1, VGA	
9	Video Storage	At least 800GB DVD	
C.	**Audio**		
1	Audio Decoding:	G.711 speech codec	
2	Audio Bit Rate:	64 kbps	
3	Audio Levels:	Line-level input/output	
4	Audio Connectors:	Three or five 3.5 mm stereo jacks	
D.	**Network Interface:**	10/100/1000 Mbps, Ethernet, RJ-45 port	
E.	**PTZ Control Interface:**	Front panel, KBD5000, or through remote client	
F.	**Alarms/Relays**		
1	Alarms Inputs:	1 per camera, programmable, 10 kohms triggered	
G.	**Auxiliary Interface:**	1 high-speed USB 2.0 port on the front panel	
		and 2 high-speed USB 2.0 ports on the rear panel	
H.	**Remote Control:**	Full remote-control operation of pan, tilts, and zoom functions via TCP/IP network	
v)	**WARRANTY**	18 months, parts and labour.	

4	**INDOOR FIXED MINI DOME SYSTEM**	
A.	The indoor fixed mini dome system with camera and lens shall be quick and easy to install.	
B.	The indoor fixed mini dome system shall provide multiple methods of installation including: surface mounting onto ceiling or wall, recessed mounting in ceiling or wall, and pendant mounting with an optional parapet mount.	
C.	The indoor fixed mini dome system shall meet or exceed the following design and performance specifications.	
i)	**ELECTRICAL SPECIFICATIONS**	
A.	Connectors	1 composite BNC ,1 UTP
B.	Input Voltage	12 VDC or 24 VAC (10%), autosensing
ii)	**VIDEO SPECIFICATIONS**	
A.	Imaging Device	1/3-inch imager
B.	Signal System	PAL
C.	Video Output	1. Composite: 1 Vp-p, 75 ohms
		2. UTP: 1 Vp-p, 100 ohms
D.	Picture Elements	752 (H) x 582 (V)
E.	Dynamic Range	102 dB typical/120 dB maximum
F.	Scanning System	2:1 interlace
G.	Synchronization	Internal
H.	Electronic Shutter Range	Auto (1/60 to 1/100,000)
I.	Lens Type	Varifocal with auto iris
J.	Focal Length	3.0 mm - 9.5 mm
K.	Operation	1. Iris Auto (DC-drive)
		2. Focus Manual
		3. Zoom Manual N/A
iii)	**CAMERA SPECIFICATIONS**	
A.	Type	Colour, high resolution
B.	Horizontal Resolution	540 TV lines
C.	Minimum Illumination	0.2 lux
iv)	**ENVIRONMENTAL SPECIFICATIONS**	
A.	Environment Indoor	
v)	**MECHANICAL SPECIFICATIONS**	
A.	Pan/Tilt Adjustment:	Manual
1	Pan	360°
2	Tilt	140° (20° to 160° range)
3	Rotation	360°
vi)	**WARRANTY**	3 years, parts and labour.

5	**OUTDOOR FIXED MINI DOME SYSTEM**	
A.	Type	Day/night, high resolution,
B.	Horizontal Resolution	540 TV lines
C.	Minimum Illumination	Colour: 0.15 lux at full frame rate B-W: 0.015 lux at full frame rate
i)	**VIDEO SPECIFICATIONS**	
A.	Imaging Device	1/3-inch pixel-based imager
B.	Signal System	PAL
C.	Video Output	1. Composite: 1 Vp-p, 75 ohms
		2. UTP: 1 Vp-p, 100 ohms
D.	Picture Elements	768 (H) x 494 (V) 752 (H) x 582 (V)
E.	Dynamic Range	102 dB typical/120 dB maximum (CW/DW models)
F.	Scanning System	2:1 interlace
G.	Synchronization	Internal
H.	Electronic Shutter Range	Auto (1/60 to 1/100,000)
I.	Lens Type	Varifocal with auto iris
J.	Focal Length	3.0 mm - 9.5 mm
K.	Operation	1. Iris Auto (DC-drive)
		2. Focus Manual
		3. Zoom Manual N/A
ii)	**ENVIRONMENTAL SPECIFICATIONS**	
A.	Environment:	Outdoor
B.	Operating Temperature:	-45°C to 50°C
iii)	**MECHANICAL SPECIFICATIONS**	
A.	Pan/Tilt Adjustment:	Manual
1	Pan	360°
2	Tilt	140° (20° to 160° range)
3	Rotation	360°
iv)	**PHYSICAL SPECIFICATIONS**	
	Construction	Aluminium with steel camera mounting bracket and polycarbonate dome
v)	**WARRANTY**	3 years, parts and labour.

5. INDOOR/OUTDOOR PTZ CCTV CAMERA DOME SYSTEM

A. The indoor/outdoor CCTV camera dome system shall be a discreet, miniature camera dome system consisting of a dome drive with a variable speed/high speed pan/tilt drive unit with continuous 360□ rotation; 1/4- inch color/black-white CCD camera; motorized zoom lens with optical and digital zoom; auto focus; and an enclosure consisting of a black box, lower dome, and a quick-install mounting.

B. The indoor/outdoor CCTV camera dome system shall meet or exceed the following design and performance specifications.

i) DOME DRIVE

A. The variable speed/high speed pan/tilt dome drive unit shall meet or exceed the

following design and performance specifications:

1. Pan Speed Variable between 400□ per second continuous pan to 0.1° per second
2. Vertical Tilt Unobstructed tilt of +2□ to -92□
3. Manual Control Speed Pan speed of 0.1□ to 80□ per second, and pan at 150□ per second in turbo mode. Tilt operation shall range from 0.1□ to 40□ per second
4. Automatic Preset Speed Pan speed of 400□ and a tilt speed of 200□ per second
5. Presets 256 positions with a 20-character label available for each position; programmable camera settings, including selectable auto focus modes, iris level, LowLight□ limit, and backlight compensation for each preset; command to copy camera settings from one preset to another; and preset programming through control keyboard or through dome system on- screen menu
6. Preset Accuracy ± 0.1□
7. Proportional Pan/Tilt Speed Speed decreases in proportion to the increasing depth of zoom
8. Automatic Power Up User-selectable to the mode of operation; the dome will assume when power is cycled, including an automatic return to position or function before power outage
9. Zones 8 zones with up to 20-character labeling for each, with the ability to blank the video in the zone
10. Motor Drive Cogged belt with 0.9° stepper motor
11. Motor Continuous duty and variable speed, operating at 18 to 32 VAC, 24 VAC nominal
12. Limit Stops Programmable for manual panning, auto/random scanning, and frame scanning
13. Alarm Inputs Ability to control 7 alarm inputs located in the back box
14. Alarm Outputs Ability to control 1 auxiliary Form C relay output and 1 open collector auxiliary output located in the back box
15. Alarm Output Programming Auxiliary outputs can be alternately programmed to operate on alarm
16. Window Blanking: 8, four-sided user-defined shapes, each side with different lengths; window blanking setting to turn off at user-defined zoom ratio; window blanking set to opaque gray or translucent smear; blank all video above user-defined tilt angle; blank all video below user-defined tilt angle
17. Patterns: 8 user-defined programmable patterns including pan/tilt/zoom and preset functions, and pattern programming through control keyboard or through dome system on-screen menu
18. Pattern Length 8 patterns of user-defined length based on dome memory
19. Internal Clock Internal system clock, user programmable
20. Scheduler Internal scheduling system for programming presets, patterns, window blanks, alarms, and auxiliary functions based on internal clock settings
21. 21. Autosensing Automatically sense and respond to protocol utilized for controlling the unit

22. Menu System Auto Flip Built-in setup of programmable functions Rotates dome 180° at bottom of tilt travel
23. Password Protection Programmable settings with optional password protection
24. Freeze Frame Freeze current scene of video during preset movement
25. Display Setup User-definable locations of all labels and displays and user-selectable time duration of each display
26. Camera Title Overlay
27. user-definable characters on the screen camera title display
28. video Output Level long video wire runs User-selectable for normal or high output levels to compensate for
29. RJ-45 Jack Contains a plug-in jack on the dome drive for control and setup of the unit, the uploading of new operating code and language file updates, and is compatible with personal computers and PDAs such as Palm™ and iPAQ™
30. Remote Data Port Compatibility Ability to set up and control unit, and upload new operating code and language file updates through the easily accessible optional remote data port; remote data port is also compatible with personal computers and PDAs such as Palm and iPAQ

C. The high resolution CCD camera shall meet or exceed the following design and performance specifications:

1. 1.Image Sensor 1/4-inch EXview HAD CCD ™
2. Effective Pixels 752 x 582
3. 3. Horizontal Resolution >540 TVL
4. Lens
   f/1.4 (focal length, 3.4~119 mm; 35X optical zoom, 12X digital zoom)
5. Programmable Zoom Speeds
6. Horizontal Angle of View 3.2, 4.6, or 6.6 seconds 55.8° at 3.4 mm wide zoom, 1.7° at 119 mm telephoto zoom
7. 7.Focus Automatic with manual override
8. 8. Sensitivity at 35 IRE 0.50 lux at 1/50 sec shutter speed (color) 0.062 lux at 1/3 sec shutter speed (color) 0.00014 lux at 1/1.5 sec shutter speed (B-W)
9. White Balance Automatic with manual override
10. Shutter Speed 1/1.5-1/30,000
11. Iris Control
12. Automatic with manual override Automatic/ off
13. Video Output 1 Vp-p, 75 ohms
14. 14. Wide Dynamic Range 128X
15. Motion Detection

User-definable motion detection settings for each preset scene, can
activate auxiliary outputs, and contains three sensitivity levels per zone

6. BACK BOX AND LOWER DOME

A. The back box and lower dome shall meet or exceed the following design and performance specifications:

1. Connection to Dome Drive Quick, positive mechanical and electrical disconnect without the use any tools
2. Trap Door Easy access trap door that allows complete access to the installation wiring, and provides compete separation of the wiring from the dome drive mechanics when closed
3. Terminal Strips Removable terminal strips with screw-type terminals for use with a wide range of wire gauge sizes
4. Auxiliary Connections 1 Form-C relay output at <40 V, 2 A maximum, and a second open collector output at 32 VDC maximum at 30 mA
5. Alarm Inputs

6. Integrated UTP Circuit Integrated circuit board that converts video output to passive UTP transmission
7. Fiber Optic Compatibility Ability to plug into back box an optional fiber optic module, or a third-party board that converts video output and control input for fiber optic transmission
8. Third-Party Control Systems Ability to plug in an optional TXB board that converts control signals from selected third-party controllers
9. Installation- Quick-mount wall , corner, pole, parapet, or ceiling adapter.
   Operating Temperatures Maximum temperature range of -4° to 45°C
   Built-in memory storage of camera and location- specific dome
10. Memory settings such as presets and patterns; if new dome drive is installed in back box, all settings will automatically download into new dome drive
11. Colors Gray Construction Dome Color Aluminum Clear, smoked, chrome, and gold versions

MANUFACTURER'S WARRANTY

A. Repair or replacement of defective parts for a period of three years from the date of shipment, including continuous motion modes.

7. CONTROL EQUIPMENT

The control equipment shall be 32- channel colour multiplexer with integral keyboard for both desktop and rack mounted operation. The operation to be duplex mode.

Features to include:

- on screen level meter for setting up VMD.
- on screen scope function to set up camera video level.
- VCR control macros to enable auto start and control via single keystroke 2 levels of menu of share user level functions.
- "convert mode" for secret recording · Keyboard lockout
- Innovative.
- On screen engineer's overview of machine set up and parameters with prints out capability via RS232 port.
- Alarm log.
- Individual dwell times.

8. CABLES AND CONNNECTIORS

All the cabling shall be carried out in conduits or trunking. Basically cables carrying video signal between cameras and TV monitoring via video control multiplexer equipment shall be coaxial multistride low loss RG59U cables. Cable connectors shall be BNC connectors. The positions for connectors and the equipments shall be directed and identified by the Project Manager on site.

Bidders shall be required to visit the proposed site to ascertain cable routes and cable lengths before pricing the Bills of Quantities in this document. In this regard, the bidders shall berequired to get in touch with the Project Manager, Chief Electrical and Mechanical Engineer during official working hours.

It shall be the responsibility of the contractor to provide wiring and connection diagrams for approval by the Project Manager.

9. 11 UNINTERRUPTIBLE POWER SUPPLY (UPS)

This shall be an on-line Un-interruptible power supply with output rating of 2KVA, 240V, 50HZ single-phase supply. It shall provide power to the security surveillance system. It shall be microprocessor- based so that both output voltage and frequency are closely regulated and continuously monitored and also provide system diagnostic and shut down protection functions.

It shall feature a maintenance by-pass to enable normal routine maintenance operations to be performed without interruptions to the system. It shall be fitted with both visual and audible alarms to indicate any change in equipment status such as:

- input power problems
- ups faults
- ups overload
- battery discharging

Other parameters are:

Input supply:	240V AC 50HZ
Power factor:	0.7 lag at full load
Current limit:	125% of the normal
Output voltage:	240V AC 50 HZ
Output voltage tolerance:	2.5%
Output frequency tolerance	: 0.05%

BILLS OF QUANTITIES

NOTES ON BILLS OF QUANTITIES

SPECIAL NOTES

1. The Contractor is required to check the numbers of the pages and should any be found to be missing or in duplicate or the figures or writing indistinct, he must inform the Electrical Engineer at once and have the same rectified.

2. Should the Contractor be in doubt about the precise meaning of any item, word or figure, for any reason whatsoever, or observe any apparent omission of words or figures he must inform the Electrical Engineer in order that the correct meaning may be decided upon or before the date for the submission of the Tender.

3. No liability whatsoever will be admitted nor claim allowed in respect of errors in the Contractor's Tender due to mistakes in the Bills of Quantities which should have been rectified in the manner described above.

4. The Contractor shall not alter or otherwise qualify the text of these Bills of Quantities. Any alteration or qualification made without authority will be ignored and the text of the Bills of Quantities as printed will be adhered to.

5. The Contractor shall be deemed to have made allowance in his prices generally to cover items of Preliminaries or additions to Prime Cost Sums or other items.

6. All items of measured works shall be priced in detail and tenders containing lump sums to cover traders or groups of work must be broken down to show prices for each item before they will be accepted. Lump sums to cover items of preliminaries shall likewise be broken down if so required.

7. The Copyright of these Bills of Quantities is vested in the Electrical Engineer and no part thereof may be reproduced without their express permission given in writing.

8. The Contractor is solely responsible for the accurate ordering of materials in accordance with the Drawings and Interior designer’s instructions and no claims for any loss or expense will be entertained for orders for materials based upon the Bills of Quantities.

9. The Bills of Quantities must be priced in Kenya Currency, i.e. Shillings and Cents.

10. In no case will any expenses incurred by Contractors in preparation of this Tender be reimbursed.

BILLS OF QUANTITIES

1. The Bills of Quantities form part of the contract documents and are to be read in conjunction with the contract drawings and general specifications of materials and works.

2. The prices quoted shall be deemed to include for all obligations under the sub-contract including but not limited to supply of materials, labour, delivery to site, and storage on site, installation, testing, commissioning and all taxes (including **16% VAT**).

3. All prices omitted from any item, section or part of the Bills of Quantities shall be deemed to have been included to another item, section or part.

4. The brief description of the items given in the Bills of Quantities are for the purpose of establishing a standard to which the sub-contractor shall adhere to. Otherwise alternative brands of **equal** and **approved** quality will be accepted.

5. Should the sub-contractor install any material not specified here-in before receiving **approva**l from the Project Engineer, the sub-contractor shall remove the Material in question and, **at his own cost**, install the proper material.

6. The grand total of prices in the price summary page must be carried forward to the **Form of Tender**.

THE PROPOSED PHASE 2 WORKS FOR THE PROPOSED RESEARCH, TECHNOLOGY AND INNOVATION LABORATORIES AND RELATED INFRASTRUCTURE ON PLOT L.R. NO. 209/5811, DUNGA ROAD, SOUTH 'B', NAIROBI

BILL OF QUANTITIES FOR STRUCTURED CABLING AND SECURITY SYSTEM INSTALLATION WORKS

The bidder is advised to visit and examine the Site of Works, the materials already installed and stored on site and its surroundings and obtain information that may be necessary for preparing the bid

RATES TO INCLUDE VAT

ITEM NO.	DESCRIPTION	UNIT	QTY	RATE KSHS.	TOTAL KSHS.
	PRELIMINARIES AND GENERAL CONDITIONS				
A	Provide bond as stated in the published conditions of sub-contract.	Sum			
B	Provide insurance as required in the sub contract conditions.	Sum			
C	Preparation of working drawings "As installed" record drawings.	Sum			
D	Printing of paper copies of item C above.	Sum			
E	Printing of 4 copies of fluke test results for each of the three blocks, network report bound, cctv report, access control report,test certificates, datasheets and warranties	Sum			
F	The Contractor's attention is drawn to legal notice No. 206 of 2015 THE PUBLIC PROCUREMENT AND ASSET DISPOSAL ACT (No. 33 of 2015) which requires payment by the Contractor for Capacity Building Levy for development of capacity through training, technical support and mentoring of the persons involved in the public procurement and asset disposal system in order to facilitate achievement of value for money in public procurement and enhance quality of public service	Sum			
	TOTAL CARRIED FORWARD TO SUMMARY				

STRUCTURED CABLING

ITEM NO.	DESCRIPTION	UNIT	QTY	RATE KSHS.	TOTAL KSHS.
	Supply, install, lay and set to work structured cabling system drawn in trunking already provided; Rates to include, Vat, labour & any others charges				
A	Category 6 4 pair UTP cable as Siemon fully wired average length 55m per point	No	400		
B	Dual RJ 45 category 6 UTP dual outlets plate complete with flush mounting plate as Siemon.	No	200		
C	Category 6A 4 pair UTP 1m patch cord as Siemon	No.	400		
D	Category 6A 4 pair UTP 3m patch cord as Siemon	No.	200		
E	Single Data/Telephone cable outlets, type RJ45 as siemon or approved equivalent, cat 6A complete with face plates.	No	50		
F	42U 1200mm deep rack/ free standing cabinet complete with locking glass, PDU, 4 fans 6 power outlet as IBM	No.	4		
G	22U 1200mm deep free standing cabinet complete with locking glass, PDU, 4 fans 6 power outlet as IBM	No.	5		
H	12U wall mounted cabinet complete with locking glass, 2 fans 4 power outlet as Toten	No.	5		
I	Category 6A 24port patch panel	No.	80		
J	24-port Cisco switch as catalyst C9200-LC-24 with cabinet Jumper Power Cord 250 VAC 13A C14-C15 connectors and required software. To also have SMARTNET 24X7X4 support, Network Advantage for an initial 1 year.	No.	4		
K	24-port Cisco switch as witch as catalyst C9200-LC-24C (uplink 100G) with cabinet Jumper Power Cord 250 VAC 13A C14-C15 connectors and required software. To also have SMARTNET 24X7X4 support, Network Advantage for an initial 1 year.	No.	20		
L	2U Horizontal patch lead organiser as Siemon	No.	60		
M	Fiber trays	No	12		
N	GBIC transceiver modules (LC to LC) multimode CISCO make for the switches	No	24		
O	Duplex Multimode SC connectors with adaptors	No.	48		
P	8 Core armored Multimode fiber cable OM3 10GBASE	LM	800		
Q	Multimode fiber patchcords	No.	78		
R	Equipment installation, termination & programming	No.	1		
S	Any other materials necessary to complete the works, Specify	item			
T	Allow for connection of fibre optic to server room by service providers	item			
	TOTAL CARRIED FORWARD TO SUMMARY				

PABX INSTALLATION

ITEM NO.	DESCRIPTION	UNIT	QTY	RATE KSHS.	TOTAL KSHS.
	Supply, install and commission IP PBX as Cisco BE 6000 and as per the specifications, attach catalogue;				
	UTP cabling is under structured cabling				
A	Supply and installation of IP PBX as Cisco BE 6000 or equivalent and approved by the engineer and with the capabilities listed below: Attach catalogue for any other IP PBX model quoted for				
	§ PSTN Telephony	Item	1		
	§ Telephony trunking protocols for T1/E1	Item	1		
	§ Number of users 1000	Item	1		
	§ Number of devices 1000	Item	1		
	§ outside sites 50	Item	1		
	§ Numberof presence 500	Item	1		
	§ Integrates voice, video, mobility, applications	Item	1		
	& voice gateway services on a single appliance	Item	1		
	§ Voice and mail boxes 800	Item	1		
	§ Number of contact centre agents 20	Item	1		
	§ T1/E1 PRI & T1/CAS ISDN-PRI Lines	Item	1		
	§ All necessary licences applicable to PBX	Item	1		
	§ Voip GSM Gateway	Item	1		
	§ Operator consoles	Item	4		
B	High end executive IP PoE SIP desktop Phones (provide catalogue showing features available)	No.	5		
C	Middle Level IP PoE Secretarial Phones (Provide catalogue)	No.	5		
D	Low level IP PoE desktop Phones (provide catalogue showing features available)	No.	5		
E	Allow for 1 year Licence for all the products under this installation from the time of handover to client	Item	Item		
	TOTAL CARRIED TO NEXT PAGE				

ITEM NO.	DESCRIPTION	UNIT	QTY	RATE KSHS.	TOTAL KSHS.
	TOTAL BROUGHT FORWARD				
A	Liaison Charges for provision of above E1 and GSM lines from telephone service providers.	Item	Item		
B	Equipment installation, termination and programming	Item	Item		
C	Cisco Wireless access point router as Cisco Aironet 1600 series for wireless internet. Fully wired, with mounting bracket, terminated and functional.	No.	10		
D	Any other materials necessary to complete the works, Specify	Item	Item		
	TOTAL CARRIED TO SUMMARY PAGE				

ITEM NO.	DESCRIPTION	UNIT	QTY	RATE KSHS.	TOTAL KSHS.
	UPS INSTALLATION				
A	Supply, deliver to site, install, test and commission modular type double inversion UPS with 1:1 redundancy (50KVA+50KVA in parallel) of total capacity 100KVA three phase in three phase output, Uninterruptible Power Supply complete with bypass switch as Tripplite/Emerson/ APC/Equal and equivalent and approved by the engineer with the provided in the specification and summarised below :- a) Total rating 100KVA b) Adequate Battery c) Back up time at 100% load – 30min d) Input Voltage 290 – 480V e) Input power factor 0.95 f) Input frequency 45 – 65 Hz g) Output Voltage 415V +_ 1% h) Output frequency 50Hz i) IP20 j) Noise level 40-55dB k) Multi-function LCD status and control console l) Audible and visible alarms prioritized by severity m) Emergency Power Off (EPO) n) Predictive failure notification o) Automatic restart of loads after UPS shutdown p) Manual bypass switch q) Internal redundancy N+1 (where N=1)				
	To be environmental friendly	Item	2		
B	Earthing comprising of copper earth electrode of size1500mm long x15mm diameter enclosed by a concrete manhole of size450x450x450mm with removable concrete cover and a 38mm diameter PVC heavy gauge conduit lead-in duct and bonded to the UPS using 10mm2 SC cable to approval	ITEM	1		
C	Supply and install type 1 SPD AS PRD1 master modular surge arrestor-3Poles +N; 350V; with remote transfer.	No	4		
D	RS 485 Cable as Belden fully connected to power meters and the Ethernet gateway EGX300 fully terminated at 30m average per point	No	4		
E	EGX300 Gateway as Schneider Electric complete with software and all necessary installation accessories	No	4		
F	Any other item required for proper operation of the UPS; (Specify)	ITEM			
	TOTAL FOR UPS CARRIED TO SUMMARY PAGE				

ITEM NO.	DESCRIPTION	UNIT	QTY	RATE KSHS.	TOTAL KSHS.
	ACCESS CONTROL SYSTEM				
	Price for ONLY installation and setting to work an IP based Passive access control system with the following for 200 doors:- **All the Door controllers and readers are already on site.**				
	Software, Door Controllers & Readers				
A	IP based Finger print biometric passive reader slim elegant design fast and accurate finger print identification with at least 4MB memory, log capacity of 50,000 events capable of both RF card and finger print operation modes with TCP/IP network interface Attach relevant catalogues	NO	200		
B	Cabling for access control using cat 6 Siemon UTP cable	No.	50		
C	Door controller, PoE capable of handling 5000 local events buffering,Supports DHCP and Static IP Addresses 4-State Alarm Monitoring and can support a local database of card holders. Attach relevant catalogues	NO	200		
D	Access Management software, SQL database, to control all doors & supports workstations	NO	3		
E	Security Management Software to integrate the management of all the doors	ITEM			
F	Installation of already supplied Proximity reader with a read range of 4.5 inches,Tristate LED feedback, capable of installtion in metallic and non-metallic environment for exit	NO	2000		
G	Access control server of sufficient capacity with software, database & configured to the approval of the engineer	NO	2		
H	Price for programming of 200 No smart/swipe cards, collection of client biometric data, programming of cards to match client use and space allocations	NO	200		
	TOTAL CARRIED TO NEXT PAGE				

ITEM NO.	DESCRIPTION	UNIT	QTY	RATE KSHS.	TOTAL KSHS.
	TOTAL B/F FROM PREVIOUS PAGE				
	Price ONLY for Installation and setting to work already supplied items below				
	<u>Ancillaries for access control</u>				
A	Enclosure with PSU and 7 amp/hr battery	NO	200		
B	Emergency Break glass switch	NO	200		
C	Override keyswitch	NO	200		
D	Door magnetic contacts	NO	200		
E	Electromagnetic locks for single shutter door	NO	120		
F	Electromagnetic locks for frameless glass door	NO	80		
G	Full height 3 arm Turnstile Bi-directional operation fully access controlled	NO	2		
	<u>COMPACT X - RAY METAL DETECTOR</u>				
	Price ONLY for Installation and setting to work already supplied scanner below				
	Compact X - RAY metal detector sa described in the specifications and summarized below: a) Password and hardware key protection b) high precision transit counter c) random alarm capabilities d) battery back up and charger e) remote control unit	No	6		
H	Associated electrical works	Item			
I	Allow for maintenance of the metal detectors during the 12 months defects liability period	Item			
	TOTAL CARRIED TO SUMMARY PAGE				

CCTV INSTALLATION

ITEM NO.	DESCRIPTION	UNIT	QTY	RATE KSHS.	TOTAL KSHS.
	Supply, install and set to work Panasonic IP CCTV system or equal and approved with cables drawn neatly in 20mm diameter conduits or trunking provided elsewhere.				
A	Wiring of CCTV camera from control room to IP camera location average length of Cat 6UTP cable 55m. Cable to 20mm diameter heavy guard conduits	No	50		
	Price ONLY for Installation and setting to work already supplied items B, C and D below				
B	SVGA/800 x 600 H.264 Pan -Tilting Network CameraBullet type weatherproof IR outdoor very high resolution IP camera as HIKVISION	No	24		
C	HIKVISION indoor IP Network camera with pan tilt zoom, 42x zoom, zero distance management, colour night view mode, 2-way audio & motion detection and PoE connectivity	No	279		
D	65" HIKVISION flat screen TV/monitor	No	12		
	Price for Supply, deliver to site, install, test and commission the items below				
E	Hikvision DS-9664NI-I8 64 Channel 4K NVR with 9T removable HDD storage complete with management WV-AS65 viewing software	No	4		
F	Hikvision DS-6904UDI Multi Channel High Definition Video Decoder for Network Surveillance System	No	4		
G	High performance Network Disk Recorder for Megapixel i-Pro Network Cameras with 9T Serial ATA HDD storage complete with management viewing software	No	4		
H	42U 1200 mm deep free standing mounted cabinet complete with locking glass, PDU 4 fans 6 power outlet as IBM	No.	3		
I	Category 6A 24port patch panel	No.	24		
J	24-port Cisco switch as witch as catalyst C9300-LC-24C (uplink 100G) with cabinet Jumper Power Cord 250 VAC 13A C14-C15 connectors and required software. To also have SMARTNET 24X7X4 support, Network Advantage for an initial 1 year.	No.	24		
K	2U Horizontal patch lead organiser as Siemon	No.	24		
L	Fiber trays	No	6		
M	GBIC transceiver modules (LC to LC) multimode CISCO make for the switches	No	12		
N	Duplex Multimode SC connectors with adaptors	No.	24		
	TOTAL CARRIED TO NEXT PAGE				

ITEM NO.	DESCRIPTION	UNIT	QTY	RATE KSHS.	TOTAL KSHS.
	TOTAL BROUGHT FORWARD				
A	8 Core armored Multimode fiber cable OM3 10GBASE	LM	200		
B	Multimode fiber patchcords	No.	15		
	TOTAL CARRIED TO SUMMARY PAGE				

STRUCTURED CABLING SUMMARY PAGE

ITEM NO.	DESCRIPTION	TOTAL KSHS.
	TOTAL BROUGHT FORWARD FROM:	
1	Preliminaries (page 1)	
2	Structured cabling (page 2)	
3	IP PABX installation (page 4)	
4	UPS installation (page 7)	
5	Access control system (page 8)	
6	CCTV installation (page 12)	
	TOTAL CARRIED TO FORM OF TENDER	

Total cost in words (Kenya shillings).....

Name of Tenderer.....

Address.....

Terms of Payment .....

Deliver Period .....

Warranty .....

Official Stamp.....

P.I.N No.....V.A.T Reg. No.....

Witness to Tenderer.....

Signature.....

Date.....