

## PROPOSED KENGEN GEOTHERMAL TRAINING CENTRE FACILITIES

# **BILL OF QUANTITIES**

## **VOLUME III OF IV**

# (Electrical Engineering Works)

## **CONSULTANTS**

### **ARCHITECTS**

AAKI CONSULTANTS ARCHITECTS P.O BOX 66091-00800 NAIROBI

### SERVICES ENGINEERS

EMPAQ LIMITED P.O BOX 68140 – 00200 NAIROBI

### **QUANTITY SURVEYORS**

SONGA OGODA & ASSOCIATES P.O BOX 54584-00200 NAIROBI

### STRUCTURAL /CIVIL ENGINEERS

PROFESSIONAL CONSULTANTS LTD P.O BOX 45792-00100 NAIROBI

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## PART A:

## **GENERAL SPECIFICATIONS**

## FOR ELECTRICAL INSTALLATIONS

### GENERAL SPECIFICATIONS FOR ELECTRICAL INSTALLATIONS

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#### **GENERAL ELECTRICAL SPECIFICATION**

#### 1 GENERAL

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

#### 1.1 **Quality of Materials**

All plant, equipment and materials supplied as part of the Sub-contract Works shall be new and of first class commercial quality, shall be free from defects and imperfections and where indicated shall be of grades and classifications designated herein.

All products or materials not manufactured by the Sub-contractor shall be products of reputable manufacturers and so far as the provisions of the Specification is concerned shall be as if they had been manufactured by the Sub-contractor.

Materials and apparatus required for the complete installation as called for by the Specification and Contract Drawings shall be supplied by the Sub-contractor unless mention is made otherwise.

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

Defective equipment or that damaged in the course of installation or tests shall be replaced as required to the approval of the Engineer.

#### 1.2 **Regulations and Standards**

The Sub-contract Works shall comply with the current editions of the following:

- a) The Kenya Government Regulations.
- b) The United Kingdom Institution of Electrical Engineers (IEE) Regulations for the Electrical Equipment of Buildings.
- a) The United Kingdom Chartered Institute of Building Services Engineers (CIBSE) Guides.
- d) British Standard and Codes of Practice as published by the British Standards Institution (BSI)
- e) The Local Council By-laws.
- f) The Electricity Supply Authority By-laws.
- g) Local Authority By-laws.
- h) The Kenya Building Code Regulations.
- i) The Kenya Bureau of Standards

#### 1.03 **Power Supply on Site**

The supply voltage will be 240 volts single phase of 415 volts 3 phase 50 Hz. TN-S system, viz. separate neutral and protective conductor throughout the system.

#### 2. INSTALLATION OF CABLES

#### 2.01 General

Bending of cables shall be in accordance with table 52c of the IEE Regulations and no cable shall be bent to radius less than that specified by the cable manufacturers.

Cables shall be rated for the maximum connected load with due consideration to the following factors: -

- (i) Voltage drop not in excess of 4% of the nominal voltage.
- (ii) Ambient temperature.
- (iii) Degree of excess-current protection.
- (iv) Grouping.
- (v) Cables run under defined conditions.

#### 2.02 Cables in conduits and Trunking

All cables shall be polyvinyl chloride (PVC) insulated to BS 6604, "PVC-insulated cables (nonarmoured) for electric power lighting", 450/750 volt grade, unless an alternative is specified elsewhere in the contract documents. The quality and size of cables contained in any one conduit shall comply with IEE Regulation 529-7 and Appendix 12.

No cable with a cross-section area of less than 1.5mm<sup>2</sup> shall be used. All cables installed in a conduit or trunking system shall be PVC single insulated conductors and shall be colour coded in accordance with the IEE Regulation 524-3 and Table 52A.

Final sub-circuits shall be run in conduits separate from main or sub-main cables. All cables in conduit shall be drawn in simultaneously. All cables shall be drawn in without the use of excessive force, Without the use of lubricants and the wiring shall be easily withdrawable.

#### 2.03 **PVC/SWA/PVC Cable**

These cables shall comprise copper conductors unless specifically detailed otherwise, laid up with PVC fillers bedded with an extruded inner PVC sheath, armoured with a single layer of galvanized steel wires, aluminium or strip as specified, and covered overall with PVC sheath.

Cables shall be manufactured to BS 6346 "PVC insulated cables for electrical supply" with conductor dimensions and resistances in accordance with BS 6360 1969, "copper conductors in insulated cables and cords", Armouring shall be galvanised steel to BS 1442.

Attention is drawn to Chapter 52 of the IEE Regulations and Appendix 9. Where the armour wires of cables are used to provide protective conductor they shall comply with the requirements of Chapter 54 of the IEE Regulations, particularly section 543; alternatively, additional cables with copper conductors shall be installed to reduce the impedance to a level which ensures compliance with Section 543 of the IEE Regulations.

Unless permission is given by the Engineer, no joints will be allowed. In the event of joints being authorized, they shall be made using plastic boxes of approved design filled with an approved cold pouring plastic or resin compound. The cable box shall incorporate suitable copper tapes and clamps to bond the armouring of the jointed cables.

The PVC/SWA/PVC cables should be terminated in the cable manufacture's approved glands. These shall be of the compression type providing controlled radial compression of the sheath seal. The gland shall incorporate an armour clamping ring and earthing ring and, where used outdoors, a lead washer shall be used to ensure a watertight joint between the gland and the unit to which it is fitted. The earthing ring shall be rigidly fixed to the item of equipment and terminated using brass nuts, bolts and washers. All gland terminations shall be protected by a PVC shroud which shall fit tightly over the cables. The electrical Sub-Contractor is responsible for determining the true nature and extent of cable routes. No claim on the grounds of lack of knowledge will be entertained. All cable routes shall be agreed with the Engineer. After the cables have been installed and terminated, but prior to putting into service, they shall be subjected to an insulation test of 500 volts and the results of these tests (recorded on test sheets) forwarded to the Engineer.

#### 3. CONDUIT AND CONDUIT FACILITIES - MILD STEEL CONDUIT SYSTEM

#### 3.01 **Conduits**

Conduits shall be installed as required by the IEE Regulations and as detailed in this specification. All metal conduits must be heavy gauge, seam welded, steel tube screwed conduits manufactured to BS 31, "steel tube screwed conduits and fittings for electrical wiring", Class B, BS 4568, "Steel conduit and fittings with thread of ISO form for electrical installation", for metric conduit, unless specified otherwise. Conduits shall be finished black stove enamelled, except in positions exposed to water (other than water used in construction), steam condensation or the action of weather, where hot galvanised conduits shall be used.

Any conduits work rejected by the Engineer shall be replaced at no extra cost. No conduit smaller than 20 mm in diameter or longer than 50mm diameter shall be used.

All bends in conduit shall be in accordance with the IEE Regulation 529-5, and made in a conduit bending machine fitted with a former of the correct radius for each conduit size.

Conduits shall be secured in an efficient pipe vice whilst being screwed. Conduit system shall be installed so as to ensure compliance with requirements of IEE Regulations 529-7. Attention is drawn to Appendix 12 of the IEE Regulations.

#### 3.02 **Conduit Fittings**

Conduit fittings shall have same finish as the conduits being used and shall comply with BS 31 or BS 4586. All conduit fittings shall be screwed or loop-in malleable iron circular type, fitted with covers secured by brass screws. Rectangular adaptable steel boxes may be used on multi-conduit runs.

All circular type boxes must be fitted with long screwed spout conduit entries with the screwed thread terminating within the spout and the edges of the internal orifice of the box rounded and smoothed to act as a bush except for the adaptable steel rectangular boxes and loop-in conduit boxes, in which case male bush and coupling must be used for conduit connections. In concealed installation, boxes shall be fixed with the rims flush with the finished surface, but when, for any reason whatsoever, the rims are below the surface, suitable extension rings of the required depth shall be provided and installed to finish flash with the surrounding surfaces and with the lids of sufficient oversize (7.5 mm minimum all round) to cover the junction between box and plaster. In no case will the use of site-manufactured bends, sets, elbows, inspection elbows or tees be permitted.

#### 3.03 Fixing of Conduits

All conduits must be firmly and rigidly fixed to be entirely without whip or movement. Space-bar saddles, or strap saddles, must be used on the timbers in roof spaces and will be allowed when the conduits are run on the underside of exposed unsealed floor or ceiling joints. Pipe hooks or crumpets will not be allowed except for security conduits in chases, or screeds, when the top of the hook must at least be 10 mm below the finished surface of the wall, or 25 mm below the floor finish. Pipe hooks shall be galvanised.

The finish of the saddles must in all cases conform to the finish of the supported conduits. Galvanised, sherardised or cadmium plated screws shall be used in all cases where galvanised conduits are installed.

The standard cast iron distance saddle, (single fixing base and two-screw fixing top), must be used for all conduits run on the surface of walls and ceilings etc., fixed at intervals of not more than 1.2 metres.

#### 3.04 Conduit Runs and Concealment

The routes of the conduit installation shall be agreed with the Engineer prior to commencing the installation. Conduits shall be installed atleast 150 mm from, and preferably under, any hot water pipes and atleast 50 mm from other surface pipes and cables. Conduits shall be bonded to other surfaces in accordance with the requirements of IEE Regulations 413-2 and 547-4 to 547-7 inclusive.

Each continuity test shall be applied to the system before plastering, screeding, or casting of concrete is commenced. Surface work will be allowed where certain pre-fabricated methods of construction preclude the concealment of the runs, and or fair-faced brickwork or block work or other unplastered walls.

Conduit runs shall be planned to obviate the need for draw-in boxes, but where the use of such boxes is unavoidable they shall be accessible at all times and be fitted with covers. When Conduits are specified as being installed on the surface the runs must be arranged to render the whole system as neat and inconspicuous as possible, having regard to the existing architectural features. All vertical and horizontal runs must be taken where conduits converge and run together near distribution centres to obtain a symmetrical layout. The distance between the conduits shall be maintained through bends and sets and shall not vary noticeably.

#### 3.05 Flexible Metallic Conduit

Flexible Conduit shall comply with the BS 731 part 1. "Flexible steel conduit and adaptors for the protection of electrical cables." It shall be used for the final connection from a rigid conduit installation to the terminal boxes of all the equipment provided with a means of positional adjustment and /or where vibration may reasonably be expected to occur.

Flexible conduits shall be PVC sheathed and shall be terminated using approved glands. In all instances a separate PVC insulated green and yellow coloured protective conductor complying with table 41A1 or 41A2 and section 543 of the IEE Regulations shall be installed, terminating at each end into purpose-made earthing terminals.

Under no circumstances will flexible conduits be accepted in lieu of sets and bends in a rigid conduit installation.

In normal circumstances flexible conduits shall have a minimum length of 300 mm and a maximum unstretched length of 800mm. It shall permit a full range of withdrawal, adjustment or movement of the equipment.

#### 3.06 Locking, Bushing and Coupling

All conduit ends must be filed square and rearmed before erection to ensure freedom from internal burrs and roughness.

Running couplings shall only be used on black enamelled steel conduit installations, and the use of this shall be kept to the minimum. All running couplings shall be secured by means of the lock nuts or lock rings, and the exposed thread painted after installation.

Every conduit connection to the equipment, boxes, distribution boards, loop-in boxes, cable trunking etc, shall be made by means of a screw coupling and a male hexagonal headed smooth bore brass bush. The smooth bore shall be fitted to secure the conduit to the item connected via a purpose-made clear hole to be closed by the bush and coupling when fitted. Paint must be removed from the surface of the item connected to allow it to be covered by the end of the coupling which shall be filed, clean and square, to ensure a good mechanical and electrical metal to metal joint. Any exposed area of metal from which paint has been removed must be made good in a matching paint. Bushes shall be fitted and tightened by means of correctly fitting spanners. Mutilated bushes damaged whilst being fitted must be removed and replaced.

Conduits connecting via couplings shall be connected by a means of 15 mm long threaded section and shall have a gap of approximately 2 mm between them. No thread shall be exposed except running couplings.

#### 3.07 **Continuity and Earthing**

The whole of the conduit installations shall be mechanically and electrically sound and continuous throughout their length in accordance with the IEE Regulations.

Where the conduit system is used to provide a protective conductor it shall comply with the requirements of Chapter 54 of the IEE Regulations particularly Section 543; alternatively, a separate protective conductor shall be installed in the conduit to comply with Section 543 of the IEE regulations.

#### 4. CABLE TRUNKING-SHEET STEEL

Trunking shall only be installed in situations which will remain readily accessible throughout the life of the buildings. No cable trunking shall be installed behind a plastered ceiling or in other inaccessible situations.

All cable trunking shall comply with BS 4678, part 1 "Steel surface trunking" and part 2 for "Steel underfloor (duct) trunking".

Sheet steel cable trunking may be used on installations employing steel conduits, for connecting two or more switchboards together or where several conduits would otherwise have to run alongside each other. Proper allowance should be made for the derating of cables installed together in a container system. The cables must be capable of carrying the current imposed by the equipment connected. Attention is drawn to Chapter 52 of the IEE Regulations, particularly Section 522, and Appendix 9: the current carrying capabilities of cables indicated shall not be exceeded. The Engineer must be consulted as to precise details concerning trunking routes and applications.

All lengths of trunking shall be heavy gauge zinc coated steel connected together by internally fitted rectangular couplings of sufficient width to provide a minimum bearing face of 25mm, to which the lengths shall be bolted on site or welded at the factory.

Adequate provision shall be made to allow for expansion.

All Tee pieces and bends shall be formed with similar means of connection and the inner radii area shall be such that cables will not be bent through a radius less than that prescribed in the IEE Regulations. Only bends and tees of approved pattern will be accepted.

All fixing screws within the trunking shall be of the round head type. The trunking shall have an over-lapping well-fitted lid securely fixed to the trunking by approved means that will avoid damage to the cables. Self-tapping screws shall not be used.

All necessary accessories including long sleeve couplings, end piece, bends, sets, tees, reducers, branches, fillets, pinracks, cable retainers etc., shall be purpose-made units rather than being fabricated on site.

Where a change in direction of trunking run occurs, the deviation should be effected by a purposemade unit manufactured on similar lines to the bends and tee pieces described above. Where this is not practical, changes in direction shall be fabricated in a neat workmanlike manner. All joints shall fit closely and gaps will not be permitted. All burrs and sharp edges shall be removed and no screw shall protrude into the trunking.

Trunking shall be firmly attached to its associated equipment either by bolted flanges or by male bushes and couplings.

Where trunking is connected to equipment by means of flange connectors, the entry into the equipment shall be of the same cross-section as the trunking.

Where trunking does not terminate in equipment, the otherwise open end shall be capped with a cover suitable bolted in position.

Where communications, extra low voltage circuits (category 1) etc., are contained in a trunking, the requisite number of separate compartments shall be provided to segregate the wiring. Where conduits are taken off such trunking they shall not pass through other compartments unless prior permission is obtained from the Engineer.

The entire trunking is required to be recessed in the structure of the building, the finished edge of the trunking is to be installed flush with the plasterwork.

Trunking runs shall be so arranged that the lid or cover plate is always on the top or side and not underneath, unless this cannot be avoided, in which case the Engineer's permission shall be obtained.

Wherever trunking passes through walls, vertical partitions etc., a fixed piece of trunking lid shall be fitted to the trunking extended 25 mm either side of the wall or other barrier, this is to allow removal of the adjacent lid without disturbing the building fabric. Care shall be taken to ensure that no opening is left between the trunking and the building structure through which fire might spread. In addition a suitable barrier of incombustible material shall be provide and fitted inside the trunking, in accordance with the IEE Regulations 528-1. On vertical runs of trunking internal incombustible barriers shall be fitted at the distance between floors or 5m, whichever is the less, in accordance with IEE Regulations 523-6.

All necessary trunking support work, hangers, brackets and fixing requirements shall be provided by the electrical Sub-Contractor.

Earth links of the appropriate size and type shall be installed at every jointing coupling, manufactured bend, etc., throughout the entire trunking system. Where trunking is used to provide a protective conductor it shall comply with the requirements of Chapter 54 of the IEE Regulations, particularly Section 543; alternatively, a separate protective conductor shall be installed in the trunking to comply with section 543 of the IEE Regulations.

In cases where sheet steel trunking is installed and there is danger of movement, a flexible earth conductor shall be installed bonding all joints in the trunking. This shall be fitted in addition to the standard earth links. Cable retaining strips shall be fitted at 1 m intervals. Insulated cable support pins shall be fitted at intervals of 4 m in vertical runs of trunking and at the top of the vertical trunking.

#### 5 CABLE TRAYS

Cable trays shall be formed from perforated steel of not less than 0.9 mm thickness up to and including 100 mm width - 1.25 mm thickness from 150 mm up to and including 300 mm width - and 2.00 mm thickness above 300 mm width. They shall be galvanised unless otherwise specified. Tray shall be adequately sized to support the cable without bunching.

Support shall be by means of steel brackets installed at intervals necessary to provide a rigid fixing and ensure that no undue deflection occurs in the complete installation. The brackets shall be galvanised prior to fixing. Dome-headed bolts, nuts and washers of finish suitable to the tray shall be used between tray and brackets.

Fixing to the surfaces of walls, ceilings, etc. shall be by means of expansion-type masonry plugs or bolts. Fixings shall be galvanised unless otherwise stated. Cable trays shall be installed using factory-formed bends, elbows, tees, couplers and risers etc. Site fabrication of elbows etc., will only be permitted with prior approval of the Engineer and where it is not possible to obtain the necessary factory-made item.

Where cuts have been made, the try shall be painted with zinc rich paint.

Holes which have been cut to allow cables to pass through shall be suitably bushed.

Suspension sets shall comprise threaded M12 cadmium plated hanger roads together with nuts and locking washers, verticle hanger brackets, support channel, tray hold-down clips etc., all of which shall have a galvanised finish.

All cables shall be securely fixed to tray work and the complete installation must be carries out in a neat and workmanlike manner without crossovers. A 25% reserve margin in size and weight shall be allowed for all cable tray works.

Cables of 30 mm diameter and above shall be fixed using the appropriate size cable straps of approved manufacture.

On light duty multi-cable runs, cable straps of plastic coated metal shall be used to secure cables.

Bunching of cables will not be permitted.

Cables shall be clipped by means of copper or brass saddles and clips where high temperature or humid conditions are likely to be experiences. In all cases, saddles, clips, straps, etc., shall be fixed to the tray by means of brass screws or bolts and nuts.

#### 6. **PROTECTION OF PVC/SWA/PVC CABLES**

#### 6.01 General

Cable routing shall be such that the maximum degree of protection against accidental damage is obtained by running cables along the inside of channels and beams, etc.

Cables shall be laid in performed trenches or duct throughout all paved areas. Ducts shall be installed for underground cables before the paving is constructed.

Cable ducts shall be sealed at both ends using materials which are resistant to any likely corrosive and insect attack in the area concerned.

All cables rising through floors and trench covers, except in switch rooms, shall be protected by a length of steel pipe which shall project at least 150 mm above the finished surface level.

The open end of the pipe shall be sealed with a suitable compound. Care must be taken that all phases of single core cables pass through the same protective steel duct.

#### 6.02 **Cables Direct in Ground**

All excavation and backfilling of cable trenches will be carried out by the Main-Contractor unless otherwise specified, but the electrical Sub-Contractor shall in any case make sure that trenches are made to a depth as specified.

The electrical Sub-Contractor shall lay cables direct in the ground in the following manner:-

75 mm (3 inches) of dry fine sand shall be placed to form a bed for the cables. After cables have been laid they shall be covered with additional dry fine sand well punned over and around the cables to a level of 75 mm above the top of the uppermost cable. Mechanical punners shall not be used for this work. The electrical Sub-Contractor shall supply and install concrete cable tiles which shall be carefully placed over the cable forming each circuit.

Until all the cables have been laid in the trench and have been covered with their protective tiles, no sharp metal tools such as spades or fencing stakes, shall be used in the trench. Rollers used during laying of cables shall have no sharp projecting parts liable to damage the cables.

#### 6.03 **Cables above Ground**

For main cable runs the cable shall be run on approved tray or ladder rack, and secured to it at intervals of not more than 400 mm horizontally and 600 mm vertically.

Cables shall be dressed together and fixed with a common saddle. If the number of cables is such as to require the tiering of cables, the number of tiers shall generally be two.

#### 7 TERMINATION OF CABLES

Cables shall be terminated in accordance with Chapter 52 of the IEE Regulations, particularly Section 527.

Cables shall be terminated by one of the following methods:-

- (i) The cable conductors shall be sweated into lugs of the appropriate size for the cable and equipment terminal.
- (ii) The cable conductors shall be secured by compression type lugs of the correct size for the cable and equipment terminal.
- (iii) The cable conductors shall be secured in pinch screw terminals.
- (iv) The cable shall be secured by means of clamps.

Where cables are required to terminate at connectors, as at lighting points, such connectors shall secure all the strands of stranded cables. Care shall be taken to ensure that cables are not damaged during preparation for termination.

Cables terminating at pinch screw terminals shall be twisted together and single cables shall have the conductor doubled back to ensure adequate purchase for pinching screws.

Cables connected to lamp holders or other components at which heat is produced shall be insulated with heat resisting material capable of withstanding, without detriment, the temperature encountered.

All terminations on PVC/SWA/PVC insulated cables shall be by compression type glands of an approved design and manufacture with facilities for clamping the armouring the outer sheath of the cable.

Glands mounted outdoors shall incorporate a seal to prevent ingress of moisture into the gland, and all glands shall be fitted with a thermoplastic shroud.

Where circular terminations are to be made, these shall be completed using Ross Counterney terminals.

Where cables are terminated in "Klippon" type terminals with parallel faced jaws, the individual cores shall be terminated using the appropriate flat or hook blade crimped lugs. Where the terminal faces are concaved, the cores shall be terminated in wires pin crimped lugs.

The electrical Sub-Contractor shall avoid multiple connections under one screw or one pin. Where more than two wires are required, a common termination jumper bar shall be used.

Terminals shall be mounted on rails or supports. All internal wiring is to be clearly marked by markers.

#### 8 SEGREGATION OF SERVICES

Cables of differing voltages shall be segregated so that there is no possibility of a fault in a power cable damaging any adjacent cables or imposing a different voltage upon them.

#### 9 IDENTIFICATION OF CABLES

All cables shall be fitted with non-corrosive cable identification bands at each end, and at all changes of direction where they leave a group of cables. All cables cores connected to equipment having marked terminals shall be fitted with non-corrosive identification bands bearing markings corresponding to those of the terminals at both ends.

#### 10. EARTHING

The whole of the metallic portion of the installation, other than current carrying parts, shall be electrically and mechanically bonded to the consumer's main earth terminal and also if applicable, to the lighting protection system or other points specified.

The installation shall be earthed in accordance with the Sixteenth Edition of the Regulations for Electrical Installation issued by the IEE, BS CP1013, "Earthing" and BS 6651' "The protection of structures against Lightning". The electrical Sub-Contractor's attention is drawn to Chapter 54 of the IEE Regulations.

A main earth terminal shall be supplied and installed adjacent to the electricity supply cable termination. The terminal shall be of ample size and capacity to suit the installation. All items of equipment, switchgear, etc., shall be bonded to this earth terminal using PVC insulated PVC sheathed cables, coloured green and yellow and sized in accordance with Tables 41A1 of the IEE Regulations. An invorine label reading "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE" in engraved upper case characters not less than 4.75mm high, shall be permanently fixed immediately adjacent to or on the earth terminal.

A heavy duty copper clamp complying with BS. 951 shall be used to bond the main protective conductor to the electricity supply cable armouring or metallic sheath (where applicable the armouring and sheath shall be bonded together).

All protective conductors shall, where possible, be enclosed within metal trunking or conduit serving switchgear, distribution board etc., so as to provide mechanical protection. Where protective conductors are run on building surfaces they shall be properly fixed and supported by means of PVC coated metal saddles along selected routes.

Earth continuity between separate items of switchgear, distribution boards etc., mounted adjacent to one another shall be affected by means of high conductivity continuous copper tape, or PVC sheathed cable, coloured green and yellow, and sized in accordance with the Table 41A1 or 41A2 and Section 543 of the IEE Regulations, connecting all items to the earth terminal.

All items of switchgear, accessories, luminaries, conduits, and the outer sheaths of MICS cables, the armouring of all PVC/SWA/PVC cables together with all other items of electrical plant and equipment shall be effectively earthed by means of a protective conductor in accordance with Table 41A1 and 41A2 and section 543 of the IEE Regulations.

At every terminal point on the fixed wiring an integral earth terminal shall be provide e.g. BESA boxes, accessory boxes etc. A protective conductor shall be provided and installed between this terminal and the earth terminal on the associated switch, socket outlet, luminaire etc.

Each circuit protective conductor shall be connected to a multi-way earth terminal provided and fixed within each distribution board. The earth terminal shall be provided with an adequate number of ways such that not more than one conductor per terminal shall be installed and the earthing conductors shall be connected in the same sequence as the current carrying conductors.

All metal piped services, e.g., Heating, Water and Gas Services, metal wastes and piped services at sinks, baths and showers etc., shall be bonded to the earth terminal in accordance with the IEE Regulations 413-2.

A 50mm section of each gas and water pipe, at position close to their entry into the relevant building, shall be cleaned and made smooth. A copper earthing clamp designed to permit the connection of protective conductors shall be provided and sized in accordance with Table 41A1 and 41A2 and Section 543 of the IEE Regulations.

The clamp shall be a proprietary type or shall be fabricated from high conductivity copper strip, minimum size 40 mm x 4 mm which shall encircle the cleaned sections of the pipe. A permanent label indelibly marked with the words, "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE" in legible type not less than 4.75 mm high, shall be permanently fixed at the points of connections.

The final connection of bonding conductors from gas, water pipes and other services to the earthing terminal shall not be completed until earth electrode and earth impedance tests have been satisfactorily completed.

Bonding connections to pipework shall be as unobstructive as possible where practicable shall be made in service ducts or accessible voids and shall be readily on the Record Drawings. All materials and sundry item shall be provided whether or not specifically mentioned, necessary to completely and effectively earth the installation. The installation shall be fully protected against dampness and corrosion and the effect of electrolytic action between dissimilar materials. A completely permanent installation shall be provided which shall be fully accessible for regular testing and inspection.

The value of earth resistance from any point of an installation to the general mass of earth shall be low enough to ensure operation of circuit protective devices and shall in any case not exceed four(4) ohms for electrical equipment, seven (7) ohms for lighting protection. Each earthing cable shall terminate in an approved design of cable lug.

Where earth conductors are run upon structures or walls they shall be fastened by means of heavy gauge non-ferrous fasteners not more than 0.75 m apart on horizontal runs and not more than 1.2 m apart on vertical runs and to give a minimum clearance of 4 mm from the fixing face.

In the event of the electrical Sub-Contractor not being able to establish a suitable earth connection to the electricity supply cable, earth electrodes shall be installed which shall be galvanised or copper clad steel extendable rods not less than 16 mm diameter and not less than 1.2 m in length. Connections to electrodes shall be made by means of solderless mechanical clamps.

To avoid corrosion, all earth system connections shall be cleaned bright and immediately covered with silicon MS4 compound or approved equal.

Earth pits, where required, shall be in accordance with the Sub-Contractor's relevant drawings, with the facility to disconnect the earth ring while measuring the electrode earth resistance.

#### 11 LIGHTNING PROTECTION

Lighting protection shall be provided on high buildings/structures more than 10 m in height. such protection shall be effected by bonding each individual building/structures <u>direct</u> to the earthing system, in accordance with the BS CP 326, by a minimum size of 170mm<sup>2</sup> conductor.

#### 12 FUSED-SWITCH UNITS, SWITCHFUSES AND ISOLATORS

The above units comply with BS 5419 and shall be 500 volt type and installed where specified and indicated on the relevant drawings.

All switchgear shall be provided with suitable locks for padlocking the switches in the 'OFF' position. The cover shall be interlocked with the operating mechanism to prevent it from being opened in the 'ON' position. This interlocking shall also prevent the switch from being closed with the cover open unless for maintenance purposes. The cover shall be gasketted to prevent ingress of dust.

The switch action mechanism shall be of the parallel operation (double break type having cartridge fuses mounted switches) and shall be ASTA certified to meet adequately all the duties specified.

The end plates shall be removable for drilling for conduit or cable entry and shall be fitted with additional distance pieces where necessary. Switchgear boards shall be fixed to the wall/floor by Rawl bolts or other approved fixings.

No building alteration shall be allowed when moving the switchboard into position, the switchboard being supplied in sections to be built in position, if so required.

Switchgear shall be delivered to site when required to suit the progress of the works. Care shall be taken to preserve the manufacturer's paint finish. Any refurbishing etc. shall be carried out, using paint obtained from the switchboard manufacturer, to the original standard of finish.

All fuses in switchgear shall be HRC fuses sized for the fused-switch units or switch-fuses etc., in which they are incorporated. They shall be ASTA certified for compliance with BS 88, Category of Duty 440 A.C 5 Class 01 and in all cases fuse links shall be selected to provide circuits discrimination.

#### 13 CONTROL PANELS AND CUBICLES

The details specified in clause 4.11 shall apply as far as fused switches, bus-bars and rating etc are concerned. The panels shall be constructed from rolled steel channel minimum size 60 mm x 30 mm deep x 5 mm or equivalent angle section clad with sheet steel of 3 mm gauge. 2 mm gauge may be used for covers and doors of not more than 1 m square.

Terminals shall be of the "Klippon" standards rail-mounted feed-through type or approved equal. All terminals shall be identified by means of numbered or lettered marking tags, which shall be identical to the number of letter applied to the cables. Cables shall be identified as terminations by means of cable markers as manufactured by "Klippon" or approved equal. 25% spare terminals capacity within wiring duct shall be provided. All components motors, starters, relays, timbers, etc. shall be labelled showing their reference and function and these shall relate to the panels' schematic wiring diagram provided with the "As-built" drawing and manuals.

All control panels shall be fitted with multi-pole isolating switches through which all electricity supplies shall pass. The door(s) of the control panel shall not open unless the isolating switch is in the "off" position. A facility to lock the control panel-isolating switch in the "off" position shall be included.

#### 14 **DISTRIBUTION BOARDS**

#### 14.1 General

All distribution boards, unless stated otherwise, shall be miniature Circuit Breaker Distribution Boards and shall be of surface or flush type, as specified. Facilities for local isolation of the distribution boards shall be provided by either a local fused-switch unit or an integral isolating switch, whichever is specified.

Where surface mounted on a flush installation, all conductors shall terminate behind the board in an adequate box. For surface mounting, trunking shall be fixed between the board and ceiling level, or conduits run directly into the board. Adequate earth continuity connection shall be made between the various components.

#### 14.2 **Fused Distribution Boards**

All fuse boards shall be of 500 volt rating to BS. 5486 part 11 "Particular requirements for Fuse boards". The details specified in clause 4.12 shall apply as far as cabinet and construction, cabling arrangements, bus bars, neutral bars, earthing and isolating switches are connected.

Fuse banks shall be spaced so as to obviate the necessity for insulating barriers, but protection shall be provided by means of insulating shields to prevent accidental contact with the main bus bars and connections.

All fuses lighting and heating circuits shall be of the HRC cartridge type, ASTA certified, for compliance with BS. 88, category of Duty 440 A.C 5 class 01.

#### 14.3 Miniature Circuit-Beaker Distribution Boards

MCB distribution boards shall comply with BS. 5486 part 12 'Particular requirements for miniature circuits-breaker boards'. The cases shall be constructed of heavy gauge sheet steel, in such a manner as to afford rigidity and maximum ease of wiring for full size circuit and main cables.

The cover shall be provided with an efficient gasket or alternatively designed with generous overlapping edges to prevent the ingress of dust. Components shall not be manufactured from zinc alloy in conjunction with sheet steel where they are relied upon for earth continuity.

Where the cover is required to be lockable, cylinder type locks shall be provided, having two keys per lock. All locked distribution boards shall be handed to the Engineering Supervisor on completion of the works. The cases shall be provided with detachable cable/conduit terminating plates, which shall be reversible and interchangeable from top to bottom.

All screws and nuts used in the construction of the case shall be fitted with shake proof washers and care taken to ensure efficient earth continuity. An external earthing terminal with cable socket shall be fitted.

All MCB banks shall be fitted to frames, with robust locking plates provided to ensure the frames rigidly in the fixed position.

The banks shall be so spaced to obviate the necessity for insulating barriers, but protection shall be provided by means of insulating shields to prevent accidental contact with main bus bars and incoming mains cable.

Bus-bars shall be of high conductivity, hard drawn copper conductors connected to the MCB contacts by means of spring washered screws or bolts, unless plug-in type MCBs are specified.

Neutral bars shall be similar to the main bus bars and shall have two screw terminals per way for rating of 30 amps or over. Single screw connections will be allowed for capacities up to 30 amps. The neutral bars shall have one terminal for each MCB within the board, and connection of conductors to the neutral bar shall be in the same order as the MCB ways.

Where installations are carried out with cables with a protective conductor, all distribution boards shall also contain internal earthing bars similar to the neutral bars detailed above, with one terminal for each MCB within the board. Earthing conductors shall be connected in the manner described for neutral conductors to neutral bars.

Where a main integral isolating switch is provided in an MCB case it shall be arranged to isolate incoming live and neutral main cables from the bus-bars. The isolator switch shall be rated at 500 volts and of the quick make-and break pattern with positive action. Incoming and outgoing terminals shall be fitted with two clamping screws and outgoing conductors to the bus-bars shall be high conductivity hard drawn copper rods.

Isolating switches shall comply with IEE Regulations, Part 537, and shall be capable of carrying their full rated load continuously and shall 'make' or 'break' their full rated load without undue burning of the contacts.

#### 14.4 Miniature Circuits Breaker (MCB)

All MCBs shall have movements which are positive in both directions (make and break) so as to enable units to be closed decisively by the operation of the handle, and to be able to assume the 'OFF' position unless the contacts are definitely separated, to safeguard against false indications.

The hand shall be trip free to make it impossible for the operator to hold the breaker in the closed position under faulty conditions. The operating mechanism and arc chambers of the circuit breaker shall be separated from the terminals and fixing screws.

Terminal identification shall be readily discernable as viewed from the front of the board with automatic and clear signal identification for both 'ON' and 'OFF' position.

All terminals shall be readily accessible from the front and each wiring chamber shall be closed by a screw fixed cover which protects the terminals and prevents dust from settling on the insulation.`

Where the full capacity of a distribution board is not required the electrical Sub-Contractor shall fix blanking plates in the vacant MCB housings. All MCBs shall be rated at 500 volts minimum, and comply with BS 3871. "Miniature and moulded case circuits breakers" and 4752 part 1, "Circuit breakers".

#### 14.5 Moulded Case Circuit Breakers (MCCB)

Where specified, MCCBs shall be of the thermal/magnetic type, having a quick make, quick break, trip free mechanism which prevents the MCCB from being closed or held against short circuits or overloads. Tripping of every multi-pole MCCB shall be such that operation ensures simultaneous action in all phases.

Clear indication shall be provide for the three positions of operation of the mechanism - 'ON', 'OFF' and 'TRIPPED'. The operation shall be such that the MCCB shall trip automatically under fault conditions and, to reset, the dolly shall require first moving through the 'off' position. All MCCBs shall be provided with facilities for locking the breaker in 'OFF' position.

All MCCBs shall be rated at 500 volts minimum, be ASTA certified for this operational duty, and comply with BS. 3871 and BS. 4752 Part 1.

#### 15 LABELLING AND ENGRAVING

#### 15.1 Labelling

All fused-switch units, switch-fuses, switches, bus-bars chambers, distribution boards etc., and all items of equipment on the main panel shall be identified in accordance with section 514 of the IEE Regulations and shall have securely fitted externally a white 'Traffolyte', 'Formica' or other approved plastic laminate label engraved with 6 mm high black letters detailing the function of the equipment and any reference number.

Red, yellow, blue, plastic laminate phase discs shall be fixed inside all switchgear and distribution boards to indicate to which phase of the supply the various circuits are connected. The colourings shall comply with Part 524 of the IEE Regulations.

Each TP or TP & N item of switchgear shall have fitted on the cover a white plastic laminate label having 'CAUTION' - 415 VOLTS' engraved in 10 mm high red lettering.

#### 5.2 Engraving

The electrical Sub-Contractor shall allow for engraving of all switched fused spurs, double pole switch accessories and any other accessories, which are customarily required. The accessory plate shall be engraved in either black or red, capital letters 5 mm high, detailing and appliance or equipment being supplied by the accessory e.g., 'WATER PUMP' etc.

#### 16 **MOUNTING HEIGHTS**

The approximate position of main switchgear, control equipment distribution boards, fittings and accessories shall be as indicated on the Drawings. Actual positions shall be determined on site by the Engineer.

Unless otherwise stated on the relevant drawings or directed by the Engineer the following mounting heights of all accessories above finished floor level shall be adhered to: -

Lighting Switches	1400 mm to centre
Socket Outlet and Spur	300 mm to centre (or 150 mm above work top level to centre)
Distribution Boards	1800 mm to lower edges.

All groups of accessories shall be in line either vertically or horizontally or as specified.

#### 17 LUMINAIRES

All Luminaires shall be of the manufacture, size and type specified and shall comply in all respects to BS 4533 "Electric Luminaires".

The electrical Sub-Contractor shall supply and install all luminaires including lamps, lamp-holders, control gear, capacitors, glassware, diffusers or other attachments, heat resistant internal cables, fuses and terminals and all necessary suspension gear. In case where Luminaires are supplied by the client the Sub-Contractor shall deliver to site store, install, commission and set to work.

Unless otherwise stated, Luminaires shall be suitable for Class 1 normal indoor environments, giving a degree of protection against ingress of moisture or dust.

All Luminaires shall be assembled and installed in accordance with the respective manufacturer's instructions/recommendations, in the position and mounting heights specified.

Luminaires shall not be installed under dirty and hazardous site conditions, and any damage or deterioration to luminaires installed under these conditions shall be made good by the electrical Sub-Contractor.

The Luminaires shall be cleaned free of dust and dirt after completion of the installation. Where dirt, dust, corrosion or other conditions cause imperfections in the luminaires, they shall be replaced.

Luminaires, diffusers, attachments or glassware etc., shall be properly stored to final erection, in such a manner as to avoid damage of any kind.

Luminaires fixings shall generally be suitable for direct connection to conduit boxes or as otherwise specified. Luminaires not provided with suitable BESA box shall be modified as necessary.

Where a flexible cord supports, or partly supports, a luminaire the maximum mass supported by the cord shall not exceed the values set out in IEE Regulations 523-32.

The minimum cross-section area flexible core to the employed shall be 0.75mm<sup>2</sup>.

Specified attention shall be given to Chapter 52 of the IEE Regulations, particularly Regulation 521-5 and 521-6, Appendices 9 and 10.

Pendant tungsten luminaires shall be fitted with heat resistant flexible cord complying with BS 6500, capable of continuous operation with a conductor temperature of 150 degrees C. The cable shall be of the circular multicore type, finished white, if not otherwise specified.

Ceiling mounted tungsten luminaires, spotlights and other luminaires of the category 'hot' luminaires shall be wired internally with cable suitable for continuous operation at 185 degree C. Where cable tails are provided they shall be of the heat resistant type capable of operation at 185 degree C.

Exterior luminaires, fixed to the walls of buildings etc., shall be wired such that final circuit wiring terminates within the luminaire. All final circuit cables so installed shall be provided with heat resistant sleaves from the connection point within the luminaire for a distance of 300 mm.

All flourescent and other discharge luminaires shall be provided with an integral fused connector block. The rating of the fuse shall be in accordance with the manufacturer's instructions to protect the internal wiring of the luminaire and to provide discrimination between final circuit protection and luminaire protection.

All recessed and semi-recessed luminaires in ceilings shall be connected by three core 0.75 mm<sup>2</sup> high temperature flexible cord from the terminals of the luminaires to a plug-in ceiling rose fixed and connected to an accessible outlet box in the wiring system, within the suspended ceiling immediately above the luminaire. The ceiling rose shall be accessible via the opening provided in the ceiling.

The electrical Sub-Contractor shall ensure that the methods of suspension for luminaires are electrically and mechanically sound.

Luminaires suspended by means of tubes shall be fitted to ball joints allowing a swing of at least 20 degrees all round. Reliable earthing between the fixed and moving parts shall be provided by means of a flexible braided copper tape.

Fluorescent luminaires shall be provided with a minimum of two fixings, except in the case of recessed modular luminaires or surface-mounted luminaires exceeding 300 mm in width, where four number fixings (one from each corner) shall be provided by means of conduit drops or threaded rods.

Normally visible luminaires support shall be conduit. All fluorescent luminaires shall be solidly mounted with all assembly nuts, bolts and accessories made tight to prevent vibrations and noise. Anti-vibration packing shall be fitted where necessary. luminaires mounted direct to trunking shall be fixed by means of the manufacturer's recommended fixing assemblies.

Unless stated otherwise, all luminaire supports shall be fixed to the building primary structure. Luminaires shall not be supported from suspended ceiling unless otherwise specified. The electrical Sub-Contractor shall be responsible for mounting and fixing arrangements.

Break joint rings of approved colour shall be provided for all suspended luminaires and fluorescent battery luminaires where the batten is of insufficient width to cover completely the conduit box and its associated clearance hole in the ceiling.

The metalwork of all luminaires shall be effectively bonded to the earthing system in accordance with Chapter 54 of the IEE Regulations.

Care shall be taken to ensure that the internal wiring of luminaires and the cable of any fixed wiring shall not be in contact with high temperature areas in luminaires.

Lighting track shall be of the type, size, finish, number of circuits and manufacture specified and shall comply with the requirements of the relevant section of BS. 4533. The positions of luminaires as shown on the Drawings are approximate only and exact position shall be determined after reference to the Engineering supervisor.

#### 18. **CEILING ROSES**

Surface mounted ceiling roses shall be of all insulated, high impact moulded plastic construction complying with BS. 67 and shall be suitable for direct attachment to conduit outlet boxes. Recessed or semi-recessed ceiling roses shall be manufactured from porcelain. Break joint rings shall be provided when used on flush conduit outlet boxes.

Ceiling roses shall not be connected to fixed wiring in such a manner that one of the terminals remains 'live' when the associated switch is in the 'off' position, unless that terminal is inaccessible to touch when the ceiling rose cover is removed, e.g. for replacement flexible cord.

Terminals shall be provided for switched live, neutral and protective conductors. Loop-in facilities shall also be provided.

#### 19 LAMPS

Lamps shall be compatible with the luminaire for which they are intended and shall be of the wattage, type and colour specified. Lamps shall be of the correct voltage rating for the particular electricity supply concerned.

Tungsten filament lamps, unless otherwise specified, shall be of the 'PEARL' type and of the longlife type giving 2000 hours average life.

Luminaires designed to accommodate lamps with reduced physical dimensions shall be fitted with lamps of the mushroom type of approved equal.

#### 20 EXTERNAL LIGHTING

External lighting system shall comprise the lighting points at the position shown on the Drawings and shall include the provision, erection and connection of all lighting columns, bollards, wall and ceiling luminaires and the provision and connection of all control gear together with the laying, jointing and connection of all necessary cables.

All excavation, trenching, backfilling etc., will be undertaken by the Main-Contractor.

All lighting columns shall be of the type specified, suitable for looping in and out three No.2 Core PVC/SWA/PVC cables of the specified size.

Where discharge lamps are specified the associated controlgear shall be mounted in the base of the column above the fused 'cut out', all on a timber board housed within the base of the column.

Each lighting column/bollard shall be completed with all adaptors, spigots, mounting brackets, luminaires, controlgear and lamps and shall be provided with a base compartment and locking door.

All column/bollards shall be fixed in the position specified.

Cable routes are shown on the relevant drawings and the electric Sub-Contractor shall lay the lighting cables in the trenches.

All connections shall be made in an approved manner, and the installations shall be finished complete and handed over in working order to the full satisfaction of the Engineer.

#### 21 LIGHTING SWITCHES

Lighting switches shall be of the type, size and manufacture as specified.

Wall and ceiling switches shall comply with BS 3676. Wall and ceiling switches controlling A.C lighting circuits shall be rated 20 amp and be of the slow break quick make, type unless stated otherwise.

Where several switches on one phase are shown at one position, a ganged box shall be used.

Where switches at any location are connected to different phases, purpose-make phase barrier switches shall be installed. The phases shall be separated by means of rigidly fixed barriers and the cable for each phase shall be confined to the area enclosed by the barriers for that phase.

Switches connected to a particular phase shall have separate cover or covers fitted over each phase. The covers shall be engraved "CAUTION 415 VOLTS".

The switch plate of the specified finish shall be fitted over phase covers to render the switch unit indistinguishable from the switches that are not phase barrier switches.

Alternatively, each gang shall have its own piping and box for each phase, physically separated from other phases with similar arrangements.

For flush position on a plastered or equivalent finish wall, the switches shall have overlapping plates.

In any places where the finish is fair-faced brickwork, the wiring shall be installed on the back of the wall and make a back entry into the accessories. Each switch in these areas shall be neatly recessed and incorporate an overlapping plate.

For surface-mounted positions and such Plant Rooms, Electrical Switch room etc., employing a surface-mounted system or wiring, switches shall be surface-mounted, having metal front plates of an aluminium finish, mounted in matching metal boxes.

#### 22 SOCKETS OUTLETS

All socket outlets and plugs shall be supplied and installed in accordance with the manufacture, type, sizes and finish specified.

All round pin 2A ,5A, 15A, and 30A socket outlets shall comply with the requirements of BS 546.

All sockets outlets shall be switched, unless otherwise specified.

All switched sockets outlets shall be complete with steel boxes of the same manufacture, complete with earth terminal.

Assemblies shall comply fully with the requirements of the IEE Regulations concerning the bonding of protective conductor terminals and each such terminal shall be connected by a conductor, having a minimum cross-sectional area of 2.5 mm<sup>2</sup>, to a permanent earthing terminal incorporated in the associated box providing an effective, solid connection to the earth continuity conductor of the installation.

Where the assembly does not provide a reliable electrical contact between the cover plate and box with effective connection of metal operating bars and toggles, then an insulated earthing lead shall be provided, solidly connected to the metal plate and operating bar or toggle and terminating at the fixed earthing terminal incorporated in the associated box. 13 amp sockets will generally be installed using ring circuits in accordance with Appendix 5, Table 5A of the IEE Regulations.

All plugs shall be of mounded rubber or other resilient material complying with BS 1363 or BS 546. The plug shall have internal cord grip. 13 amp plugs shall be fitted with cartridge fuse links to BS 1362. The fuse rating shall be selected to give protection to the flexible cord or cable connected.

All fuses installed within 13 amp plug top, fused spurs, clock connections etc., shall be cartridge fuse links rated at 240 volts, ASTA certified for compliance with BS 1362 'General purpose fuse links for domestic and similar purposes', or BS 464 'Cartridge fuse links (rated at up to 5 amperes) for AC and DC service', or BS 2950 'Cartridge fuse-link for telecommunications and light electrical apparatus'.

All equipment, which is locally fused, shall have fitted fuses with characteristics, which are recommended by the manufacturer of the equipment.

If any appliance or equipment suffers due to incorrect fusing of the appliances, such appliances or equipment shall be repaired or replaced at the electrical Sub-Contractor's cost, to the satisfaction of the Engineer.

#### 23 INSPECTION AND TESTING

A visual inspection shall be made in accordance with IEE Regulations 612-1. References shall be made to appendix 14 of the IEE Regulations, which is a checklist for initial inspection of installations.

The electrical installation shall be inspected and tested by the electrical Sub-Contractor in accordance with part 6 of the IEE Regulations.

Where any part of installation is to be concealed within a building, fabric tests shall be made to ensure that the installation is satisfactory prior to concealment.

Upon completion of the works the whole installation shall be subjected to the tests detailed hereafter and every defect shall be noted, corrected and brought to the notice of the Engineer.

All tests shall be witnessed by the Engineer to his full satisfaction and he shall be given at least one week's notice in writing of the proposed tests.

All labour and test instruments shall be provided by the electrical Sub-Contractor and the instruments shall be correctly calibrated and certified for the limits of accuracy required and shall be operated by competent person. If, in the Engineer's opinion, a particular instrument is not suitable, then an acceptable alternative shall be provided. The Engineer shall be at liberty to demand the use of any testing instrument or apparatus that he may reasonably consider to be necessary in the execution of the testing.

In the event of the installation failing to pass the test, the Engineer has the full authority of the Employer to deduct from the Contract Price all reasonable expenses incurred, due to him being required to attend a repetition of the test.

The following items, where relevant, shall be tested in the sequence indicated. Standard methods of testing, in respect of some of the following regulations of this section, are given in Appendix 15 of the IEE Regulations.

- i) Continuity of ring final circuit conductors.
- ii) Continuity of protective conductors, including main supplementary equipotential bonding.
- iii) Earth electrode resistance.
- iv) Insulation resistance.
- v) Insulation of site-built assemblies.
- vi) Protection of barriers or enclosures provided during erection.
- vii) Insulation of non-conducting floors and walls.
- viii) Polarity.
- ix) Earth fault loop impedance.
- x) Operation of residual current devices and fault voltage operated protected devices.

Upon completion of all tests and commissioning, two copies of detailed certificates shall be provided by the electrical Sub-Contractor to show that the equipment, materials, installation etc., have been tested and commissioned. One copy of each, duly completed and signed shall be submitted to the Engineer within 154 days of the results being obtained. The second copy of the certificates shall be retained to be included with operator and maintenance manuals. The results of the test and details of completion for the electrical test shall be detailed on the Test and Completion Certificates respectively; issued by the National Inspection council for Electrical Installation Contracting or other approved authority.

#### 24 AS BUILT DRAWINGS, AND DOCUMENTATION

Within one month of the date of completion the electrical Sub-Contractor shall provide 3 prints of all electrical drawings showing the electrical installations "As built". In case the electrical Sub-Contractor fails to provide "As Built" drawings as required, these will be prepared by others at the expense of the electrical Sub-Contractor.

#### **APPENDIX 1**

#### SUPPLEMENTARY SPECIFICATION FOR PVC INSULATED CABLES

#### AND NON-METALLIC CONDUITS WIRING SYSTEM.

#### 1. **PVC 1 CABLE**

The wiring shall be carried out in 250-volt grade or 440 volt grade for 3-phase PVC Insulated cable, as specified elsewhere run in non-metallic conduit. The cable shall be of the sizes specified on the drawing.

#### 2. INSTALLATION OF WIRING

Cable shall be drawn into accessories, distribution boards and switchgear <u>after</u> the erection of the conduit system. Under no circumstances shall it be permitted to draw cable into an incomplete section of the conduit installation.

#### 3. JOINTS IN CABLES

The wiring shall be carried out on the looping-in principle. All joints shall be made at the terminals of main switches, distribution boards, ceiling roses, switches and socket outlets, etc. and fixed apparatus only. No joints shall be made in boxes unless approved.

#### 4. **CAPACITY OF CONDUITS**

The cable shall run in the conduit so as not to exceed the capacities as set out in Table 10 of the IEE Regulations (13<sup>th</sup> Edition with current amendments).

Conduits shall be best quality new super high impact grade heavy gauge 'A' riding PVC unplasticised conduits as manufactured by Egetude limited suitable for plain connections.

Conduit of sizes less than 20 mm shall not be used without the written authority of the D.R.

#### 5. **BENDING**

The conduit shall be bent and formed strictly in accordance with the manufacturer's instructions: -

- i) Small size, i.e. 20 and 25 mm shall be bent cold by inserting the correct size bending spring. It is essential for right angle bends that the conduit is bent past 90 degrees to allow for "spring back".
- ii) Large size of conduit shall be pre-heated before inserting rubber cord to prevent kinking. Conduit badly formed or bent or damaged in any way, shall not be used.

#### 6. JOINTING

Joints shall be made water-tight by the use of 'Egaweld' cement applied with a brush or rug. 'Egaweld' shall be applied to the complete circumference of conduit. Conduit shall be thoroughly cleaned at the ends to ensure a good adhesion of the fittings. 'Egaweld' shall not be permitted to enter into the conduit.

#### 7. **CONDUIT FITTINGS**

All conduit fittings and accessories, including couplers, ordinary clips, saddles, pipe hooks, reducers, stopping plugs, lockouts and male and female bushes shall be manufactured dimensionally, similar to B.S.S. 31/1940. Solid tees shall not be used . Solid inspection elbows or bends or inspection tees shall be used only in exceptional circumstances and then only with D.R.'s approval.

Where it eases the installation of cast-in-situ back entry boxes on the loop-in system, purpose made bends manufactured by Egatube and comprising a tight bend with a push socket at one end and a threaded socket at the other end may be used with the D.R.'s approval.

#### 8. **FIXING OF CONDUITS**

Conduit shall be installed on the loop-in system and shall either be cast-in-situ in the main concrete structure, concealed in chases cast in concrete walls, or chases cut in solid partition walls, run in ceiling spaces or in hollow partitions of floors, or concealed below the floor screed, whichever shall prove to be the most suitable method of installation for use in the building under construction. Unless it is clearly specified or shown on the drawing, the method of installing conduit shall be subjected to the approval of the D.R.

Sunken conduit run in chases in walls shall be fixed by means of mild steel pipe hooks or nonmetallic saddles spaced not more than 1 m apart. Where conduit is concealed behind plaster it shall be sunk to a depth of either 10 mm below finished plaster level, or installed flush with the structural wall level before application of plaster, whichever is the lesser depth.

Conduit fixed on the surface of walls or ceiling shall be fixed by spacer bar saddles fixed not more than 1 m apart.

Surface conduit shall also be fixed 230 mm on both sides of all boxes, the box itself securely fixed. Where such an arrangement of boxes and saddles would prove to be both unsightly and unnecessary, short lengths of conduit not exceeding 1 m in length between boxes need not be secured further than by connection to the adjacent boxes. In such cases the D.R. reserves the right to insist upon additional fixing being provided, should he for any reason whatsoever consider such additional fixing necessary.

Where two or more lines of conduit run parallel to each other, on the surface of walls, etc., the distance between them shall not be less than 15mm and conduits shall not cross.

Conduit shall be installed in such a manner as to prevent interference with other services and shall be kept at least 180 mm clear of gas or water pipes, and heat in excess of 68 degrees C.

A means of expansion shall be provided in conduit runs in excess of 6 m without any bend or set, by use of 'Egetude' expansion couplings, which shall also be used at building expansion joints.

Conduit cast-in-situ shall be frequently secured to the steel reinforcement work, with heavy binding wire to prevent movement of the conduit and conduit boxes during the pouring and vibrating of the concrete. Outlet boxes shall be securely fixed to the shuttering with nails, or by means, which shall be visible as a marker on removal of the shuttering only where marks can be concealed. Conduit shall be installed after the first grid of steel reinforcement work is securely fixed and all open ends of conduits shall be protected by couplings plugged with a suitable non-metallic stopping plug. The number of right angle bends in conduit cast-in-situ shall not exceed two between boxes.

Immediately prior to installation the wiring all conduit and fittings shall be dried and cleaned out by drawing through a cloth swab. Rawl plugs shall be used for fixing to brickwork, self-tapping screws for fixing to aluminium section, raw nuts, raw-anchors spring toggles, gravity toggles or rawlbolts, shall be used for fixing to other materials as approved by the D.R.

Corners shall be turned by easy bends or sets made in accordance with the manufacturer's instructions without altering the section or splitting conduit.

#### 9. CIRCULAR INSPECTION

Boxes will not be permitted in floors unless approved. Boxes cast-in-situ must face downwards from the ceiling/floor section. Small standard circular non-metallic conduit boxes, conforming dimensionally with B.S. 31/1940 with standard circular non-metallic (4mm) lids and nylon fixing screws, shall be provided and fixed at all junctions.

The above circular boxes or equivalent looping boxes shall be provided and securely fixed for all ceiling points. When the conduit is run on the surface, all circular boxes for ceiling points shall be fixed with screws.

Where ceiling roses occur and the ceiling box is recessed below the finished level of the ceiling, suitable extensive rings to accommodate the ceiling rose must be provided. Where ceiling boxes, including extension rings, are flush with the ceiling surface, break joints rings shall be provided to hide the joints.

Where a non-metallic outlet box of thermoplastic material is used for the suspension of a lighting fitting, care shall be taken to ensure that the temperature of the box does not exceed 60 degrees c. The weight suspended from the box shall not exceed 3 kg.

Where wiring system incorporates galvanised conduit and trunking, the trunking shall be deemed to be galvanised 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 circumstance 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 other insulating substance shall be removed from the screw threads. Where conduits terminate in fuse-gear, distribution board, adaptable boxes, non-spouted switchboxes, etc., they shall, unless otherwise stated, be connected thereto by means of smooth bore male brass brushes, compression washers and sockets. All exposed threads and abrasions shall be painted (using an oil point for black enamelled tubing and galvanised tubing immediately after the conduit. The inner radius of the bend shall not be less than four (4) times the outside diameter of the conduit. Not more than two right angle bends will be permitted 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 15 m. No tees, elbows, sleeves, either of inspection or solid type, will be permitted.

Conduit throughout shall be of sufficient section and so arranged with draw-in boxes to allow easy drawing in and out of any one or all of the cables in the conduit.

Conduits shall be swabbed out prior to drawing in cables, and they shall be laid so as to drain off all condensed moisture without injury to end connections.

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

Conduits installed and buried in walls shall allow a minimum of 15 mm cover. These conduits and those cast-in-situ concrete slabs shall be given one coat of rust prevention paint before installation of conduit and before concrete is placed. Sunk circular conduit boxes shall be provided with break joint rings of white moulded material or metal.

Surface conduit shall be run in square symmetrical lines and shall be marked on site for approval before installation. Conduits shall be fixed by means of distance saddles spaced at not more than 1.2 m for 20mm and 50mm conduit and 1.5 m for larger sizes. Conduits shall be fixed each side of conduit boxes at a distance not exceeding 250 mm, and the saddles shall be equally spaced.

Where conduit runs enter specified areas requiring flameproof equipment, barrier boxes shall be inserted immediately before the conduit enters the flameproof area.

All conduit installed within this area shall be solid drawn galvanised, as shall be conduit fittings and accessories and Buxton Certified as suitable for Group 11 Hazards. Equipment shall comply with B.S 229, B.S.S. 889, and Code of Practice C.P. 1003. In no case shall conduits from different distribution boards be connected at one box, likewise cables from different distribution boards shall not be housed in the same conduit specified.

All conduit boxes, except loop-in pattern concrete floor shall be fixed direct to the structure apart from the support provided by the conduits. Box lids where required shall be heavy gauge metal, secured by means of zinc plated or cadmium steel screws. All adaptable boxes and lids of the same size shall be interchangeable.

Boxes used in conjunction with mineral insulated copper sheathed cable boxes shall be galvanised and painted after erection.

Draw-in boxes in the floor are generally to be avoided but where they are essential they must be grouped in positions approved by the D.R. and covered by suitable floor straps, with non-ferrous tray 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 fillings of all covers, but the fillings in materials will be supplied and the filling shall be carried out by the Main Building Sub-Contractor.

Where it is intended to fix enclosed lighting fittings directly to a box to suspend a fitting of weight in excess of 3 kg., Egetude steel insert clips shall be used.

#### 10. SWITCH AND SOCKET OUTLET BOXES

All boxes intended for switches, socket outlet or other outlets shall be fitted with brass ferrules to accommodate fixing screws.

#### 11. **STOPPING PLUGS**

All spare ways in junction boxes, etc., left for possible future extensions shall be fitted with the stopping plugs.

#### 12. **EARTHING**

Where fittings and accessories require earthing, an earth continuity conductor be run through the conduit. The earth continuity conductor shall be a green coloured PVC insulated copper wire of minimum size 2.5 sq. mm and shall be continuous between terminals. Where the earth terminal is formed by a brass screw and washer, "Ross Courtney" type terminations shall be used. All switch, socket outlet, ceiling boxes etc., shall be supplied with an earth terminal.

#### 13. EARTH CONTINUITY

Each final sub-circuit that is required to be earthed shall be provided with its own individual earth continuity conductor which shall be run from a terminal on the earth bar in the distribution board or consumer's control unit protecting any particular final sub-circuit.

## PART B:

## **PARTICULAR SPECIFICATION**

## FOR ELECTRICAL INSTALLATIONS

### PARTICULAR SPECIFICATIONS FOR ELECTRICAL INSTALLATIONS

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#### PARTICULAR SPECIFICATIONS

#### **SECTION 1: GENERAL**

1.01 The electrical Sub-Contractor shall supply labour and supply, deliver, install, fix, connect, test, label, and commission the electrical works, clean, complete and working to every detail as described in the specification and by related specifications to the satisfaction of the Consulting Engineer/ Project manager.

#### 1.02 Exclusions

Excluded from this Sub-contract is:-

i) Control panels for motor-starters and internal wiring between control-panels, motor thermostat etc.

#### **SECTION 2**

#### SUPPLY AND DISTRIBUTION

#### 2.01 Supply and Distribution system

The power supply shall be from the existing MV switch board located in the Switch room. The external distribution shall be effected through underground cables to run in a ducted distribution system.

#### 2.02 Main Switch Board

Mains power distribution ducts are shown on the drawing.

The schematic for main switchboard are shown on drawing. Transformer room details, including trenching, are as shown on the drawings

All switch fuses, fuse switches, MCB's including meters shall be of reputable manufacture meeting current British and Kenya Standards as stipulated in the general specifications. Any other quality that do not strictly meet these standards shall not be acceptable.

Unless specifically stated otherwise, vertical power distribution shall be via riser (bus-bar) trunking. All circuit breakers in the Main Switchboard to be motorized and set at different timings to allow for sequential loading of the standby generator. Exact trunking details to be given at the time of approving shop drawings for the main switchboard.

#### **SECTION 3**

#### LIGHTING AND SMALL POWER INSTALLATIONS

#### 3.01 INSTALLATION SYSTEM

With the exception of where otherwise noted on the drawings, the installation shall throughout be carried out in PVC insulated copper cables of not less than 1.5 mm<sup>2</sup> copper drawn in high grade PVC conduit.

#### 3.02 LIGHTING CONTROL SYSTEM

#### **Indoor Lighting**

3.03 Types of accessories and fixed apparatus to be used shall be as manufacture MK or Crabtree. Subject to the approval of the Engineer equivalent makes may be used. All light fittings to be of manufacture shown on the detailed descriptions, or approved equivalent.

#### 3.04 CONNECTIONS TO FIXED APPLIANCES

The Sub-contractor shall supply and interconnect flexible cords between spur units /outlets boxes and the appliances where the symbol for flex connections are shown.

All connections shall be made by white heat-resisting PVC flexible cords having fuse rating in accordance with the respective circuits subjected to a minimum of 0.75 mm<sup>2</sup>.

#### 3.05 MOUNTING HEIGHTS AND LOCATIONS

All mounting heights stated shall mean the heights from finished floor level to underside of the accessory.

Each mounting height for wall fixtures shall, however, be re-confirmed on site.

#### Lighting control Switches

1400 mm above floor level and 100 mm away from architrave. If mounted in a column they shall be located in the centre.

#### **Sockets Outlets**

400 mm above finished floor except for areas that are otherwise stated.

#### **Connection Units and Outlets**

Connection units having cord outlets shall be located as to limit the length of the flex cord to approx. 600 mm and be located slightly higher than the inlet on the appliances. The same applies to outlet boxes.

#### **Conduit Boxes (General)**

Where one fitting is shown in a room the box shall be in the centre (unless otherwise stated). Where two or more fittings are to be installed they shall be half of the between two fittings. Where one row of fittings is to be installed they shall be located in the centre. Where installed between beams they shall be in between two beams. All boxes shall be with covers.

#### 3.06 WALL AND CEILING FINISHINGS

The Sub-Contractor is to obtain information regarding the ceiling claddings before any installation is commenced as he will be held responsible if the conduit boxes as well as boxes for switches and socket outlets, telephone, etc are not installed at the right depth.

#### 3.07 LIGHTING FITTINGS

The sub-Contractor shall supply, deliver to site, install and commission all the fittings.

The tenderer may submit an alternative schedule of equal makes of fittings with the tender where applicable.

Where appliances fittings shall be supplied complete with bulbs or tubes, the tubes shall be as Thorn Manufactures. The bulbs shall also be Thorn make. Equivalent makes may be substituted subject to due approval of the Engineers, and the sub-contractor proving that what is specified is not available.

#### 3.08 FIXING AND LOCATION

Details of fixing and location of various fittings are as shown on relevant drawings.

Fluorescent and incandescent fittings shall, in addition to being fixed to the conduit boxes, also be fixed by means of PVC covered raw plugs (no wooden plugs) at the fixing centres.

A rubber gasket shall be fitted on the conduit boxes for the outdoor fittings in order to provide a waterproof seal.

3.09 All switch panels shall be as MK manufacture or equivalent subject to the Engineer's approval. Each panel shall be fed from a particular phase as NOT more than one shall be allowed inside one panel. Separate conduits shall be installed to each panel.

#### 3.10 **POWER INSTALLATIONS**

The sub-Contractor shall include for all installations shown on the drawings.

The sub-contractor shall satisfy himself that there is a continuous conduit, trunking and /or duct system to facilitate installation of the entire power installation and shall be held responsible where continuity does not exist.

#### 3.11 INSTALLATION SYSTEM

The installation system for the indoor installation shall be carried out in concealed PVC conduits, PVC ducts and surface mounting trunking. The size of the cables shall not be less than  $2.5 \text{ mm}^2$  for ring main circuits.

### **SECTION 4**

#### 4. FIRE ALARM SYSTEMS

#### 4.01 INSTALLATION

The sub-contractor shall ensure continuous conduit link-up between individual break-glass call units, detectors, bells and panels.

#### **SECTION 5**

#### INSTALLATION FOR COMMUNICATION AND SECURITY SERVICES

#### 5.01 **INSTALLATION SYSTEM**

In the tender for electrical installations supports for all cables in the communications and security services shall be included. The electrical tender shall include for trunking, conduits etc. to ensure a continuous supply system from the telephone switch room to any individual outlet.

Holes in structures shall be provided by the main-contractor.

The conduits shall at each point terminate in deep switch-boxes as specified for lighting control switches.

#### 5.02 MOUNTING HEIGHTS AND LOCATIONS

Mounting heights shall be as for socket outlets.

#### 5.03 **BLANK-OFF PLATES**

As supplied by client.

## PART C:

# TECHNICAL SPECIFICATIONS FOR FIRE DETECTION AND ALARM SYSTEM

### TECHNICAL SPECIFICATION FOR FIRE ALARM SYSTEM

CONTENTS

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#### SECTION A:

#### 1.0 SYSTEM DESIGN

#### 1.1 The Code of Practice for design, installation and servicing

This specification is for the design and installation of fire detector alarm systems for general applications and is based on BS5839 Part 1: 1988.

#### **1.2 Property Protection**

A satisfactory fire alarm system for he protection of property will automatically detect a fire at an early stage, indicate its location and raise an effective in time to summon the fire fighting forces (both resident staff and fire brigade).

The general attendance time of the fire brigade should be less than 10 minutes. Therefore an automatic direct link to the fire brigade is essential.

#### **1.3** Life Protection

A satisfactory fire alarm system for the protection of life can be relied upon to sound a fire alarm while sufficient time remains for the occupants to escape.

#### 2.0 ZONE DETAILS

#### 2.1 Zoning of the system

To ensure a fast and unambiguous identification of the fire source, the protected area should be divided into zones.

When determining the area to be covered by a zone, consideration should be given to accessibility, size, the fire routine determined for the premises, and particularly in occupied premises, that each zone is accessible from the main circulation routes leading from the where the control panel is sited.

In general the following guide lines for the size of a zone should be observed:

- 1. If the total area (i.e. the total of the floor areas of each storey) of the building is not greater than 300m<sup>2</sup> then the building need only be one zone, no matter how many floors it has.
- 2. The total floor area for a zone should not exceed 2000m<sup>2</sup>.
- **3.** The search distance should not exceed 30m. This means the distance that has to be travelled by a searcher inside a zone to determine visually the position of a fire should not exceed 30m. The use of remote indicator lamps outside doors may reduce the number of zones required.
- 4. Where stairwells or similar structures extend beyond one floor but are in one fire compartment, the stairwell should be a separate zone.
- 5. If the zone covers more than one fire compartment, then the zone boundaries should follow compartment boundaries.
- 6. If the building is split into several occupancies, no zone should be split between two occupancies.

Notes:

- 1. A fire compartment is an area bordered by a fire resisting structure usually at least 30 minutes resistance.
- 2. Zone limits can be relaxed only in certain manually operated systems.
- 3. It may be an advantage to have manual call points on separate zones to detectors. This will avoid misleading information regarding the position of fire, particularly on staircase landings.
- 4. Removal of a detector from a zone circuit must not isolate a break glass call point on the same circuit.

#### **3.0 ADDRESSABLE SYSTEMS**

In an addressable system several zones may be connected to the control panel by a single loop circuit.

Maximum area covered by one loop is 10,000 sq m.

In addressable systems the detector or manual call point in alarm can be shown by the use of an alpha numeric display. This on its own will not be acceptable and the zone in which the detector/manual call point has operated must be displayed.

The zonal indication may be mounted adjacent to the control panel, and the plan of the building/floor should also be displayed. This means, the use of mimic diagram would seem to be the most suitable means for zone identification.

However in small systems where the identification of location of an incident by an individual device is not confusing, then zonal information may not be required.

#### 4.0 BREAK GLASS AND MANUAL CALL POINTS

The break glass call point is a device to enable personnel to raise the alarm in the event of a fire, by simply breaking a frangible element and thus activating the alarm system.

The following guidelines should be observed for the correct siting and positioning of break glass call points:

- 1. Break glass call points should be **located on exit routes** and in particular on the floor landings of staircases and at all exits to the open air.
- 2. Break glass call points should be located so that no person need travel more than 30m from any position within the premises in order to give an alarm.
- 3. Generally, call points should be fixed at a height of 1.4m above the floor, at easily accessible, well-illuminated and conspicuous positions free from obstruction.
- 4. The method of operation of all call points in an installation should be identical unless there is a special reason for differentiation.
- 5. Manual and automatic devices may be installed on the same system although it may be advisable to install the manual call points on separate zones for speed of identification.

#### 5.0 ALARM SOUNDERS

An important component of any fire alarm system is the alarm sounder, normally a bell or electronic sounder, which must be audible throughout the building in order to alert and/or evacuate the occupants of the building.

The following guidelines should be observed for the correct use of alarm sounders:

1. A minimum sound level of either 65dBA or 5Dba above any background noise likely to persist for a period longer than 30 seconds, whichever is greater should be produced by the sounders at any occupiable point in the building.

- 2. If the alarm system is to be used in premises such as hotels, boarding houses etc., where it is required to wake sleeping persons then the sound level should be 75dBA minimum at the bedhead.
- 3. All audible warning devices used in the same system should have a similar sound and be distinct from any other audible alarms used for other purposes. Except in noisy areas where high performance sounders may be required.
- 4. A large number of quiter sounders rather than a few very loud sounders may be preferable to prevent noise levels in some areas from becoming too loud.
- 5. It is unlikely that sounder noise levels in a room will be satisfactory if more than one dividing wall or door separates it from the nearest sounders.
- 6. The level of sound provided should not be so high as to cause permanent damage to hearing.
- 7. The number of fire alarm sounders used inside a building should be sufficient to produce the sound level recommended, but should in any case be at least two.

#### 5.1 Other requirements include:

- 1. The sounders should be arranged on at least two separate circuits, so that the failure of one circuit does not case all sounders in the building to fail.
- 2. Frequency range between 500 1000Hz.
- 3. Most single doors will cause a 20db drop in sound level. Fire doors 30db.
- 4. Where mains sounders are being used to supplement 24V DC sounders, the 240V AC supply should be monitored.
- 5. To achieve 75db at the bedhead, a sounder should be installed in the bedroom.

#### 6.0 SELECTION OF EQUIPMENT DETECTION TYPES

When choosing the type of detector to be used in a particular area it is important to remember that the detector has to discriminate between fire and the normal environment existing within the building, i.e. smoking in hotel bedrooms, fumes from forklift trucks in warehouses, steam from bathrooms, kitchens etc.

#### 6.1 Heat detectors

Heat detectors may be the Point type (which responds to temperatures surrounding one particular spot), or the Line type (which responds to temperature change along its line).

All Point type heat detectors should include a fixed temperature element operating at a pre-determined temperature. Some may also include a rate-of-rise element designed to operate in response to a rapid rise in temperature. Heat detectors are in general less sensitive than other types of detector and should therefore not be used where a small fire will cause unacceptable losses.

#### 6.2 Smoke detectors

There are two principal methods of smoke detection: the ionisation chamber, and the optical scatter chamber. The detection method chosen will usually depend on the type of risk to be protected against. In the ionisation chamber, an electric current flows between two electrodes and is reduced by smoke. Ionisation detectors are particularly sensitive to small particle smoke such as that produced in rapidly burning fires but are relatively insensitive to large particle smoke such as that produced by overheated PVC or smouldering polyurethane foam. In the optical chamber, light is scattered, or in some cases absorbed by smoke. Optical detectors are more sensitive to large particles found in optically dense smoke, but are less sensitive to the small particle smoke.

Today, optical smoke detectors are more widely used than ionisation types due to the growing use of flame retardant materials in building construction, decoration and furnishings. Careful consideration must be given to any specific risks that might occur.

#### 6.3 Siting and spacing of detectors

In a building the greatest concentration of smoke and heat will generally collect at the highest parts of the enclosed areas and it is here therefore, that detectors should normally be sited. Heat detectors should be sited so that the heat sensitive element is not less than 25mm, nor more than 150mm, below the ceiling or roof. If a protected space has a pitched or north light roof, then smoke detectors should be installed in each apex. The following parameters should be followed when spacing detectors:

The maximum horizontal distance between any point in the area and the nearest detector:

#### 1. Under flat horizontal ceilings and corridors more than 5m wide

- i) For Point type Heat Detectors 5.3m (maximum area 50m<sup>2</sup>)
- ii) For Point type Smoke Detectors 7.5m (maximum area 100m<sup>2</sup>)

Heat Detectors

Max area of coverage per detector =  $50m^2$ 

Max distance covered = 5.3 m (for square layout this is 3.5m to wall 7m between detectors)

Smoke Detectors

Max area of coverage =  $100m^2$ Max distance covered - 7.5m (for a square layout this is 5m to wall, 10m spacing)

#### 2. In a corridor less than 5m wide (where adjoining rooms are protected by automatic detection)

ADD to the maximum horizontal distance 50% of the difference between 5m and the actual width of the corridor.

e.g.: In a 2m wide corridor, the difference between: 2m and 5m = 3m 50% of 3m = 1.5m Maximum distance of travel for a Point type Smoke Detector = 7.5m + 1.5m = 9m

#### 3. In the apex of a pitched or north light roof

A row of detectors should be sited in the apex. One row of detectors should be sited at the highest point, a minimum distance of 0.5m from the vertical wall.

ADD to the maximum horizontal distance 1% for each degree of slope up to a maximum increase of 25%

e.g.: A Point type detector at the apex of a 20 degree slope. 20% of 7.5m = 1.5m Maximum distance of travel 9m The maximum area of coverage may also be increased proportionally.

#### 4. Obstructions

- (i) Where the passage of smoke or hot gas from a position to a detector is likely to be disturbed by a ceiling obstruction (such as a beam) having a depth greater than 150mm, but less than 10% of the height of the ceiling, then the horizontal distance should be decreased by twice the depth of the obstruction.
- e.g.: For a point type smoke detector obstructed by a beam of 200mm depth Maximum distance of travel

= 0.2 x 2 = 0.4 m7.5m - 0.4 m = 7.1 m

- (ii) Where a ceiling obstruction, such as a beam, is greater than 10% of the height of the ceiling then the areas either side of the obstruction should be considered as separate rooms.
- (iii) Ceiling beams less than 150mm can be ignored.

#### 5. Detectors (Other than beam type)

Detectors should not be mounted less than 500mm from any walls or partitions. Where rooms are divided into sections by walls, partitions or storage racks reaching within 300mm of the ceiling, the dividers should be considered as if they reach the ceiling.

#### 7.0 LIMITS OF CEILING HEIGHT

Detectors should not normally be mounted on ceilings higher than the general limits on Table 1 below. If small sections of a ceiling (not exceeding in total 10% of the ceiling area) exceed in height the general limits of the table , those higher sections may be protected by Point type heat detectors provided that the ceiling height in the higher sections does not exceed 10.5m, or by Point type smoke detectors provided that the ceiling height in the higher sections does not exceed 12.5m.

Limits of ceiling height			
Detector type	Ceiling heights in metres		
	General Linnis	Kapiu attenuance	
Heat detectors BS5445: Part 5			
Grade 1	9.0	13.5	
Grade 2	7.5	12.0	
Grade 3	60	10.5	
Point smoke detectors BS 5445:	10.5	15.0	
Part 7			
High temperature heat detectors	6.0	10.5	
BS 5445: Part 8			
Optical beam smoke detectors	25.0	40.0	
BS 5839: Part 5			
Siting limits for smoke beam detectors		<b></b>	
	Minimum (m)	Maximum (m)	
Height of optical beam above floor	2.7	25.0*	
Height of optical beam above hoor	2.1	23.01	
Ontical hear length	10.0	100.0	
Optical Scall length	10.0	100.0	
Distance of ontical heam from a flat ceiling or			
apex	03	0.6	
up en	0.0	0.0	
Horizontal distance between optical beams			
measured at right angles to a beam		14.0	
6 6			
Horizontal distance between optical beam and	See Note	7.0	
an adjacent wall or partition.			

\* The height may be increased to 40m provided that the rapid attendance criteria are met.

**Note:** Generally the beam should not pass closer to the wall or partition than 500mm, and not closer to an obstruction than 500mm. However, up to 3m of the beam may be closer than this.

#### 8.0 CEILING HEIGHT LIMITS WITH RAPID ATTENDANCE

Although an increased ceiling height means that the fire will be larger when it is detected, the size of the fire when fire fighting starts will also depend on the delay between detection and the start of fire fighting. If this delay is small, then the increase in fire size at detection due to a higher ceiling can be acceptable.

If the detection system is automatically connected to the fire brigade either directly or via a central (fire alarm) station and the usual attendance time of the fire brigade is not more than 5 minutes, then the rapid attendance limits of ceiling height given in the table in the top right may be applied. If small sections of a ceiling (not exceeding in total 10% of the ceiling area) exceed in height the limits of the table in the top right, those higher sections may be protected by Point type heat detectors if their height does not exceed 18 metres.

#### 9.0 CONTROL EQUIPMENT

The control and indicating panel will depend on the size of the protected building and the extent of the automatic protection provided.

Specification of equipment would be based on numbers of zone circuits, sounder circuit, battery standby, remote center link ancillary control relays, and other individual customer requirements.

Next to the control unit should be a diagrammatic plan showing zone locations.

Siting of control and indication equipment

- 1. In an area of low fire risk
- 2. On the ground floor by entrance used by the fire brigade.
- 3. In an area common to all building users.
- 4. Where automatic detectors are in use, the control equipment area must be protected.
- 5. Alarm sounder must be sited next to the control unit.

#### **10.0 STANDBY POWER SUPPLIES**

Standby supplies will usually be from secondary batteries with automatic chargers. These batteries must have an expected life of at least 4 years and the code specifically bans the use of automotive type batteries.

When the mains supply fails the standby must be able to operate the alarm load for 30 minutes after a certain minimum duration. The minimum duration varies with the type of system and building occupancy.

For life protection (L) if a mains failure will be recognized within 12 hours, a standby duration of 24 hours is required. If the 12-hour requirement is not likely to be met, a standby of 24 hours after the detection of the fault is required.

For property protection (P) if the mains failure will immediately be recognized then a 24 hours standby is required, if not, then the required duration is 24 hours longer than the building may remain unoccupied.

#### 11.0 WIRING

The satisfactory operation of a fire alarm system depends on the interconnection of its components. Some interconnections may have to function correctly for significant periods after being attacked by fire, e.g. cables to power supplies, control equipment and sounders.

Other cables must function when a trigger device operates, but are not needed after an alarm has been raised, e.g. cables to manual call points, smoke detectors and heat detectors.

Cables can therefore be classed in two groups:

- 1. Cables permissible if operation is not required during fire, e.g. Cables to manual call points, smoke and heat detectors.
- 2. Cables permissible if operation is required during a fire, e.g. Cables to power supplies, control equipment and alarm sounders.

While mineral insulated cables are preferable for fire alarm applications, the following cables can be used for the two groups:

#### Group 1

- 1. MICC to BS 6207: Part 1 with or without PVC sheath.
- 2. Cables complying with BS 6387 at least in categories AWX or SWX or A or S.
- 3. **PVC** insulated to BS 6004 sheathed or non-sheathed with mechanical protection.
- 4. Rubber insulated to BS 5007
- 5. **PVC** single type **BK**, **BR** and **BU** to BS 6231.
- 6. **PVC** insulated **SWA** to **BS** 6346
- 7. Cross-linked polyethylene or hard ethylene-propylene rubber insulated SWA
- 8. to BS 5467
- 9. Polyethylene insulated PVC sheathed coaxial cable to the dimensional requirements of BS 2316: Part 3 but with a minimum of 16-strands/0.2mm diameter central conductor.
- 10. Cables designed for the detection of heat.

#### Group 2

Cables 1 & 2 in Group 1 may be used for Group 2 applications. All the other cables shown above may also be used provided that they are protected either by burying them within a wall and covering them with 12mm of plaster or equivalent, or protecting them from a significant fire risk by shielding them with a wall, partition or floor having a minimum demonstrate 0.5 hour fire resistance.

These requirements may in certain cases be reduced when included in areas of low risk or when covered by an automatic extinguishing system.

Certain cables may also need mechanical protection against impact, abrasion or rodent attack. As a guide, cables 1, 6 and 7 above will not need further protection but all others may in risk circumstances. BS5839 Part 1 gives full details.

Other types of cables can be used provided that their suitability can be clearly demonstrated.

Conductors carrying fire alarm power or signals should be separated from conductors used for other systems.

#### 12.0 INSTALLATION OF CABLES

Cables should be installed in accordance with the good practices recommended in the latest edition of the IEE wiring regulations.

Connection to a mains supply should be via an isolating switch fuse reseved solely for the purpose. Its cover must be painted red and labelled **fire alarm – do not switch off.** 

Conductor size should take voltage drop into account. In any case conductors should have a cross-sectional area of not less than 1 square mm or, if stranded, of not less than 0.5 square mm.

Where possible, cables should be routed through areas of low fire risk.

Cables installed in damp, corrosive or underground locations should be PVC sheathed. Where there is a risk of mechanical damage, cables should be protected accordingly.

Cables in cavities or voids should be separated from other cables by 300mm, unless enclosed in a conduit, ducting or trunking.

Screened cables complying to be BS 7629 can be run in duct or tray without segregation.

#### **13.0 ROUTINE TESTING OF SYSTEM**

The system should be regularly tested and serviced. BS5839 Part 1 makes the following recommendations:

Daily

- (i) Check that the panel indicates normal operation. If not, record any fault indicated in the event log and report the fault to a responsible person.
- (ii) Check that any fault recorded for the previous day has received attention

Weekly

- (i) Operate a manual call point or smoke detector to ensure the system operates properly. Each week a different detector should be checked.
- (ii) Check that the sounders have operated and then reset the system
- (iii) Check the battery connections.
- (iv) Complete the event log with details of date, time, trigger device tested and enter "**Routine** Weekly Test" the "Action Required" and reported to a responsible person

#### Quarterly

- (i) Check entries in the log book and take any necessary action.
- (ii) Examine the batteries and their connections.
- (iii) Operate a manual call point or smoke detector to ensure the system operates properly, checking that all sounders are operating.
- (iv) Check that all functions of the alarm control panel operate by simulating fault conditions.
- (v) Visually check that structural alterations have not been made that could have an effect on the siting of detectors and other trigger devices.
- (vi) Complete the event log with details of date, time, trigger device tested and "Quarterly Test" in the event sections. Any defects or alterations to equipment should also be entered.

Annually

- (i) Carry out an inspection as detailed for the quarterly inspection.
- (ii) Every detector should be tested in situ.
- (iii) All cable fittings and equipment should be checked to ensure that they are secure and undamaged.

#### **SECTION B:**

#### 14.0 ANALOGUE ADDRESSABLE FIRE DETECTION SYSTEMS

# Analogue Addressable Systems provide combined enhanced detection sensitivity and reduced false alarm potential to create a safer, trouble-free detection environment.

Analogue addressable systems should achieve levels of fire detection and protector which embrace the virtues of fast and accurate response and high levels of detection sensitivity with a significantly reduced false alarm potential.

The addressable system to meet the following:-

- The requirements of BS. EN54 Pt. 2 and 4: 1998
- Installer-friendly 'plug in' feature
- 2km maximum loop length
- Up to 120 devices per loop.
- Other Required Features:-
- Programmable sounder circuits direct from control panel.
- Capability to add manual sounder circuits, via loop alarm interface units.
- Sounders wired directly on to the detector loop
- Large capacity high intensity LCD-8 lines, with 40 characters per line
- Capacity for repeater panels on loop
- Facilities for on-site programming
- Password protected user and service menus
- Networking facility
- Dirty detector fault warning facility
- Day/night sensitivity adjustment capability
- Coincidence detection
- Pre-alarm facility
- Power supply remote option

#### 14.1 Network Capability

The loop control panels should be capable of being interconnected easily to produce larger systems.

When a fire or fault condition is detected on any of the control units an event message is passed to all the other panels connected to the system. It should be possible to interconnect fire detection systems on larger sites to form a single-site network.

Within information from individual panels, available across the network, an overall fire plan, involving alerting or evacuating affected parts of the site can be implemented.

When a fire or fault condition is detected on any of the control units, an event message is passed on to all other panels connected to the system. Each panel will then display event information such as panel number, loop, zone/sector and address data. Alarm line operation across the network can be facilitated using zone and sector numbering.

Alarm sounder options

Alarm sounders can be connected to the system as follows:

(i) On dedicated alarm lines, wired directly from the control panel. Four and eight separate alarm outputs to be are provided in the two and four loop control panels respectively.

Each alarm circuit to be separately programmable to activate from any designated zone or zones of devices on the detection loop.

- (ii) Additional alarm lines to be connected to the system via alarm line interface units. Each unit to provide four programmable alarm line outputs and be capable of being positioned anywhere on the detection loop wiring.
- (iii) Where loop-wired sounders are used, these should be connected directly on the detector loop wiring. These units to be programmed either to sound a general alarm or be individually operated by a signal from any designated zone or zones of detection devices-hence offering a complete analogue addressable system on a single pair of wires.

Electronic sounders to give sound outputs complying with the requirements of BS5839 Pt 1: 1998. The sounders to be capable of giving various sound types.

#### 14.2 Additional programmable features

The following additional features to be programmed into the system:

- address to zone number allocation (up to 128 zones)
- address to device type (e.g. detector or call point)
- zone, address, device type and sector text (24 characters each)
- zone or sector intermittent alarm pattern allocation
- 2 stage alarm timer
- zone or sector to auxiliary relay timed operation. Further relays may be added by using remote relay interface units.
- auxiliary input operation (e.g. silence/sound/evacuate etc)
- 40 characters of site text displayed by the panel in normal state, with the time and date.
- customer fire or fault programming
- double knock/coincidence
- day/night sensitivity
- adjustable detector threshold levels

#### **15.0 SYSTEM FEATURES**

#### **Styled for the buildings of tomorrow**

Information relating to the status of the system to be clearly indicated via the panel's alphanumeric 8 line, high intensity liquid crystal display.

#### **15.1 1, 2 or 4 Loop options**

The panels to be capable of being connected to either 1, 2 or 4 detector loops each loop being up to 2 km in length and 4 or 8 programmable sounder circuits, respectively.

Additionally, the panels to be capable of being networked together to provide even higher levels of detection and alarm system capacity. When networked, each panel to be configured to provide information relating to the entire fire detection system, thus enhancing the level of building safety.

#### 15.2 Operation

Access level one controls to be positioned on the front of the panel, for ease of operation. Level two controls are to be concealed behind a key operated cover, and once exposed, they should enable the operator to interrogate the system's memory to obtain information on the location, status and progress of any fire incident.

Further levels of control, for example the disablement of, and reinstatement of detectors and zones, to be available via a security access code.

The system's memory to be capable of recording historical information relating to the minimum, maximum and current analogue levels received from any address, providing the facility for the constant monitoring of detector condition and a record of 'normal' fluctuations in the environment at each location, for simplification of routine testing and maintenance procedures.

#### 15.3 Installation

Each panel to be supplied with address modules 1-60 for each loop. These are to be inserted into each appropriately numbered detector or call point on the system. Address modules 61-120 to be supplied separately to cater for systems with more than 60 addressable devices per loop.

#### 15.4 Standard

The system to comply with BS EN54 Pt 2 1998 – Control and Indicating Equipment (CIE) and BS EN54 Pt 4 1998 – Power Supply Equipment (PSE)

#### 16.0 SYSTEM OPERATION

#### **16.1 Operational characteristics**

The following is a brief summary of the main functions and the expected operational characteristics of the system.

Adjustable pre and full alarm facilities

Adjustable pre and full alarm thresholds to be set for individual detector addresses.

Once a pre-alarm threshold has been reached, a signal to be sent to designated locations, alerting those responsible for system monitoring, that the potential for a fire incident may exist. When the full alarm threshold is reached, the system to automatically provide warning signals to pre-determined areas of the system, for purposes of facilitating orderly evacuation of those areas affected.

A day/night operation facility to be provided to give a desensitized level of detection during the day and full sensitivity during night time operation, without affecting immediate alarms from manual call points.

Automatic detector fault facility

High and low- level fault thresholds to be indicated. If a device's analogue level drifts, over a period of time from its normal background value, a fault indication to be given at the panel, showing the address of the detector. The detector can then be inspected and serviced or replaced if necessary. This facility to be included to increase building safety through simplification of routine maintenance, and testing.

Line extensions

Alarm and relay extension lines to be connected at any address on the analogue detection loop, using the appropriate interface.

Repeater facility

The dedicated repeater panel to be either connected to the detection loop, or spurred directly from a panel, if preferred. The Repeater Unit to be supplied with an 80-character LCD and integral power supply unit.

• Enhanced detector addressing

Each system to be programmed to provide an address/detector indication for each device, which enables a 'DEVICE TYPE ERROR' indication to be displayed at the control panel in the event of a wrong device being fitted.

PC control colour graphics and date acquisition facility

This add-on package, to feature a PC and monitor, complete with software and the origination of up to 12 site plans. Additional plans can be added as extras.

#### SECTION C: ANALOGUE ADDRESSABLE DETECTORS

#### **17.0 ANALOGUE DETECTORS**

The analogue photoelectric smoke detector is ideally suited to the detection of slow burning fires. It employs an infra-red-light source and photodiode to provide early warning of a hazard. Smoke particles entering the detection chamber cause light scatter, which is detected by the photodiode. The detector to be resistant to false alarms caused by dust, insects, high humidity and draughts.

#### 17.1 Analogue Ionization Smoke Detector

Particularly suitable for identifying clean burning fires. The detector to incorporate twin sampling chambers which provide enhanced stability and inhibit the potential for false alarms caused by changing environmental conditions.

Analogue Heat Detector to be capable of being configured by the control panel to operate either as a fast response, medium response heat detector, or a high temperature detector.

**Common Mounting Base** to be compatible with detectors (both analogue and conventional). The base to incorporate a secure locking tab and position indicator, facilitating the correct orientation of the detector for optimum viewing of the detector's LED.

#### **18.0 ANALOGUE REPEATER PANELS**

#### Analogue Addressable Repeater Panel

The repeater unit to incorporate a  $2 \times 40$ -character liquid crystal display, with the optional facility of an integral printer. Additional features to include own log, to receive and store information from the main panel, and an output to facilitate the addition of a mimic repeater panel. The standard unit to be surface or flush mounted.

Slimline Mimic Diagram (SMD)

The slimline machine is designed to augment the information provided by main or repeat panel.

The SMD helps to maximize alarm flexibility, whilst reducing system wiring to an absolute minimum.

The module is installed either as a sounder detector base or as a stand-alone wall or ceiling mounted unit. Either option is accommodated directly on the two-wire detector loop.

The fully programmable SMD to allow alarm organization on a single sounder, zonal or general alarm basis.

The self-powered facility to allow up to 120 detection devices and up to 55 addressable sounders to be connected on to the loop wiring.

The SMD to have selectable tones, continuous intermittent or warble. To be used in systems designed to BS5839 Pt 1. The sound output to be rated at 93 dB.

Addressable Sounder

The loop wired addressable sounder is to be used with analogue addressable fire systems.

Installed either in conjunction with a detector or on a stand-alone basis, the sounder is addressed and powered directly from the detector loop.

The unit to provide a sound level of 85 dBA, and offer continuous intermittent or warble sound types, all within the recommended BS5839 Pt 1 frequency.

Each analogue loop to have a maximum of 30 units.

#### **19.0 LOOP INTERFACE UNITS**

To help provide input/output signals from anywhere on the loop wiring. This device to enable automatic operation of building plant in the event of a fire or the interface with existing fire detection or fire extinguishing systems to be easily incorporated.

Alarm/power supply interface units to allow additional alarm lines to be wired from any loop location. Each unit to provide the facility for using four independent programmable alarm circuits (1A maximum per alarm line, 3A maximum load). Alarm lines to be controlled without the need to wire directly back to the panel.

**Relay/power supply interface unit** to provide four additional programmable relay contacts (5A, 30 VDC) to enable output signals for operating external equipment.

This unit to have a dedicated 240VAC supply and should be capable of being connected at any address location on the detection loops.

**Interface units, loop maximums.** A maximum of 3 alarm interfaces and 4 relay interfaces may be connected to each loop controller, with each loop controller controlling two loops.

As a two loop panel contains a single loop controller, a maximum of 3 alarm line interfaces and 4 relay interfaces may be connected to loops 1 and 2 or a combination of both. A four loop panel contains 2 loop controllers enabling a maximum of 3 alarm interfaces to be connected to either loop 1 or 2 with a similar number on either loop 3 or 4.

**Short circuit isolator** provides protection of the detection loop. This ensures that the remainder of the loop protected by the short circuit isolator arrangement continues to function should a fault occur.

**Standard interface unit** enables a spur, containing a maximum of 5 standard detectors, and an unlimited number of conventional call points to be connected to the detection loop. UP to 10 interface units may be connected to a loop. Conventional call points should be wired before conventional detectors on any spur circuit. They should not be mixed.

**Input/Output interface unit** provides both input and output signals directly on to the loop. Input signals from other fire protection systems can be displayed at the control panel. Output signals can be provided in order to operate plant shut down or door release equipment.

#### 20.0 ADDRESSABLE BREAK GLASS CALL POINTS

The call point is addressed in a similar manner to the addressable detector bases, using the same set of address modules. There is no restriction on the number that may be used on a loop, up to a maximum of 120 address points. An LED indicator is incorporated as standard to confirm that the unit has operated.

#### Weatherproof break glass call point

For exterior applications, where required.

# PART D:

## TECHNICAL SPECIFICATIONS FOR 500KVA PRIME RATED SOUND-ATTENUATED GENERATOR INSTALLATIONS

## PART E: TECHNICAL SPECIFICATIONS

SUPPLY AND	INSTALLATION OF	<b>150KVA PRIME</b>	RATED SOUND-	ATTENUATED GE	NERATOR
SET					

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#### **TECHNICAL SPECIFICATIONS**

#### 1. SCOPE OF WORKS AND SERVICES

1.1 The work covered by this specification includes the supply, delivery, installation, setting at work, commissioning to the satisfaction of the Project Manager/Engineer and maintenance for a period of twelve months, of one Diesel Engined Generating Set complete with all necessary auxilliary equipment and as indicated.

#### 2. RELATED DOCUMENTS

- 2.1 The specification shall be read in conjunction with the Preliminaries, conditions of contract and any supplementary specification(s), schedule(s) and drawing(s) issued with it and enumerated in the invitation to tender. In the event of a discrepancy between this specification and any drawing issued with it or forming part of the contract the drawing shall be followed.
- 2.2 The words 'as indicated', 'where indicated', 'unless otherwise indicated' refer to items or requirements indicated elsewhere in the tender documents issued in connection with the contract e.g. on a drawing, in a supplementary specification or in Schedule 1.

#### 3. **REGULATIONS**

- 3.1 The equipment shall comply with all relevant statutory standards and regulations current at the date of tender (unless otherwise indicated) and in particular the following:
  - 1) I.E.E. Regulations for the Electrical Equipment of Buildings.
  - 2) Regulations under the Electrical Power Act.
  - 3) Factories Act.
  - 4) Any special regulations issued by the local Electricity or Water Undertakings.

#### 4. STANDARDS

4.1 The equipment and all components shall comply with all relevant British Standards and Codes of Practice or other equal and approved standard specifications and codes. Where the equipment or part of it complies with other internationally recognized standards which are less stringent than British Standards or Codes or Practice, then the difference is to be stated in writing and must accompany the tender submission.

#### 5. **OPERATING CONDITIONS**

- 5.1 The equipment and all components shall be suitable for operation in ambient conditions of 5° to 40° centigrade and up to 100% relative humidity in an unheated ventilated building.
- 5.2 All ratings of equipment and components shall be interpreted as site ratings and NOT sea level or other ratings. Details of the site are given in Schedule 1.
- 5.3 Sub Contractor is deemed to have visited the site and if unable to locate it to apply to EMpaq Limited, P.O. Box 68140-00200, Nairobi, for directions to enable him to do so. The Sub-Contractor is deemed to have acquainted himself therewith as its nature, position, means of access, etc., and no claim in this connection will be allowed. No claim will be allowed for travelling or other expenses which may be incurred by the Sub-Contractor in visiting the site or preparing a tender for the contract works, and subsequent site visits to be called by the Architect during the contract period.

5.4 The set shall be capable of operating continuously and satisfactorily in a medium dust laden atmosphere as defined in BS 1701 and in accordance with BS 5514.

#### 6. FUNCTIONAL REQUIREMENTS

- 6.1 As specified in Schedule 1, the set shall be used for emergency operation (standby power operation). It shall be possible to start, operate and stop the set manually independently of any automatic features.
- 6.2 Within the operating conditions specified (Section 5) the set shall be capable of starting and accepting full load within the shortest possible time and in any case not more than 10 seconds. Any special features included to achieve this shall be stated in Schedule 2.

#### 7. **PERFORMANCE**

- 7.1 The output rating of the set in kVA, the voltage, the number of phases and the frequency shall be as specified in Schedule 1.
- 7.2 Within the operating conditions specified, each set, equipped with its standard air intake filters, shall be capable of delivering its rated output continuously at rated voltage and 0.8 lagging power factor and of delivering 10% in excess of the continuous maximum for a period of one hour in any 12 hour period.
- 7.3 The steady state voltage shall be maintained within 2½% of the rated voltage under the control of the voltage regulator between the cold start ambient conditions and the maximum working temperatures, at any load from no load to 10% overload and from unity to 0.8 lagging power factor. After any change of load the voltage shall not vary by more than plus or minus 15% of the rated voltage and shall return to within plus/minus 3% within 3 seconds and to within plus/minus 2.5 % of rated voltage within 15 seconds. On starting the voltage overshoot shall not exceed 15% and shall return to within 3% in not more than 3 seconds.
- 7.4 The governing of the set shall be such that the steady load speed band shall not exceed 1% of rated speed. Sudden removal of the full load at rated frequency shall not cause the frequency to rise above 10% of rated frequency and it shall return to within 5% of rated frequency within 3 seconds. The resultant steady state frequency shall return to 4% within 15 seconds. If full load is then reimposed the frequency shall not fall below 94% of rated frequency and shall return to 99% within 3 seconds and to the rated frequency within 15 seconds.
- 7.5 The cyclic irregularity of the set at full load shall not be worse than 1/150.
- 7.6 The deviation of the waveform of the voltage output from a pure sine wave shall not exceed the limits specified in BS 2613.
- 7.7 Radiated interference shall be suppressed to the limits specified in B.S. 800 and B.S. 833.

#### 8. SET ARRANGEMENT

- 8.1 The set and its auxiliaries shall be mounted on a sufficiently substantial underbase. All items which must be held in correct relative alignment shall be located by means of dowels.
- 8.2 The set shall be designed and supplied for operation bolted to the floor on robust antivibration and shock absorbing devices.It shall have adjusting screws for optimum setting and levelling and be so designed and installed that no appreciable engine vibration shall be transmitted to the floor or to any surroundings.

8.3 A new generator house will be constructed. The Sub-Contractor shall provide early enough full details of fixing requirements, and any modifications that may be necessary for the proposed house and foundation. Particularly, the Sub-Contractor appointed to supply the generator must confirm if the proposed house is adequate for the generator in terms of height, length, width and provision of natural ventilation. The Sub-Contractor will be responsible for the cost of modifying the generator house if he fails to provide the above information immediately.

The Sub-Contractor shall however provide means for bolting down the set. If the plinth provided is not sufficient the Sub-Contractor shall arrange to extend it to the Architect's satisfaction.

8.4 Bearings shall be suitable for operation over long periods without the need for replacement of the lubricant. Oil lubricated bearings shall be fitted with a visible oil level gauge.

#### 9. **DIESEL ENGINE**

- 9.1 The engine shall be designed for satisfactory operation on fuel oil complying with BS 2869 Class D and the lubricating oils stated in Schedule 2.
- 9.2 The governor shall control the frequency with the limits stated in Section 7.4. Manual speed adjustment shall be provided over a range  $\pm$  5% of the rated speed at any load.
- 9.3 The engine shall be totally enclosed, with forced lubrication from an integral pump having on the suction side a coarse strainer and on the delivery side a dual 'full flow' fine filter fitted with a changeover cock incorporating pressure by-passes, so that the oil flow to the engine is maintained if the filter should chock.

Alternatively a single filter of the self-cleaning type fitted with a by-pass relief valve and having the same filtration performance may be provided. The capacity of the lubricating oil system shall be sufficient to enable the engine to run continuously for 72 hours.

- 9.4 A filter fitted with by-pass relief shall be inserted in the fuel line immediately before the pump(s). The fuel filter element shall be incapable of passing particles larger than 5 micrometers. The fuel system shall be so arranged that fuel resulting from filter, pump or pipe spillage shall be incapable of entering the engine pump.
- 9.5 Air filters complying with BS 1701, Grade 'A' or Grade 'B' suitable for use in a medium atmosphere shall be fitted on the engine air intake(s).
- 9.6 No significant critical speed of the complete shaft system, including the generator, shall be within 15% of the rated speed.
- 9.7 A manually reset overspeed trip shall be fitted to stop the engine if its speed exceeds the rated speed by 15%. A mechanical trip is preferred but an electrical overspeed trip may be offered. Both types shall be equipped with a pair of contacts which close on operating of the trip. If the device is belt driven, at least two belts shall be provided and the drive shall be capable of carrying full load with one belt removed.
- 9.8 The set shall be arranged such that on shut-down the cooling water temperature shall not rise with residual heat so that the high water temperature lock-out operates (Section 23.1 (4) (a)).
- 9.9 The engine shall be naturally aspirated as indicated in Schedule No. 1.
- 9.10 Starting shall be by means of electricity supplied from a starter battery. The starter motor shall be of the axial type, de-energised by a device operated from the engine.
- 9.11 Suitable means shall be provided for turning by hand the engine main shaft and the associated generator to facilitate inspection and overhaul. A means of manual starting is to be provided as indicated in Schedule No. 1.
- 9.12 The engine shall be capable of being started from any crank position.

- 9.13 A thermostatically controlled 240 volt immersion heater may be fitted in the engine lubricating oil sump to facilitate starting. The heating surface loading of any lubricating oil heater(s) shall not exceed 0.015 watt per sq. milimetre to avoid carbonisation of the oil.
- 9.14 An efficient exhaust silencer with adequate draining facilities shall be supplied, and as indicated in Schedule 1 shall be installed in the generator house with the exhaust discharge into the steel chimney. The exhaust silencer shall be so arranged that it may be readily relocated if required.

#### 10. FUEL STORAGE TANK

10.1 The fuel storage tank shall be located close to the building and in the current Kenya laws relating to fuel storage close to buildings or be mounted on a plinth, which shall be properly fenced. Type of location is given in Schedule 1.

A minimum capacity of the tank shall be as per schedule 1. The tank shall be fitted with a hand operated fuel transfer pump and the necessary piping to allow the transfer of fuel from it to the daily service tank.

- 10.2 A three-way cock shall be fitted in the line from the tank to the engine to enable fuel to be supplied from a source other than the fuel tank. The position of the cock shall be clearly marked "TANK", "OFF" and "AUXILLARY".
- 10.3 The daily service fuel tank shall be equipped with a clearly visible plastic tube fixed vertical on its side to enable the level of the fuel in the tank to be seen readily. In addition to that it shall be supplied with drain, vent, overflow and inlet and outlet connections.

#### 11. ENGINE INSTRUMENTS

- 11.1 The following instruments shall be provided:
  - 1) a lubricating oil pressure gauge
  - 2) a tachometer
  - 3) a water thermometer
  - 4) an exhaust gas pyrometer or thermometer mounted near the manifold.
  - 5) lubricating oil thermometers on the inlet to and outlet from the engine, when a lubricating oil cooler is fitted.

#### 12. COOLING SYSTEM

12.1 The engine shall be both air cooled and water cooled as indicated in Schedule 1.

#### **13.** AIR COOLING OF ENGINE

- 13.1 Cooling air for the engine and lubricating oil shall be provided by fan(s) mechanically driven from the engine. The cooling system shall be adequate for the total requirements of the engine when running on continuous full load and on 10% overload for one hour in accordance with BS 5514 and under the conditions of Section 5.
- 13.2 The engine shall be so designed that the cooling air discharges into or is drawn through a reasonable airtight ducted assembly enclosing the lubricating oil cooler, the cylinder barrels and the cylinder heads of the engine.

This assembly shall terminate in a flanged outlet to which trunking shall be readily attached, to enable hot air from the cooling system to be ducted and discharged outside the building together with exhaust.

Belt driven fans shall have at least two belts and the drive shall be capable of transmitting the full load with one belt removed. The cooling air temperature shall be controlled so as to maintain a safe working temperature of the cylinder head(s) and the engine shall shut down if the maximum is exceeded (see section 22.1 (4) (b)).

#### 14. WATER COOLING OF ENGINE

- 14.1 A radiator of the air blast type shall be provided. It shall either have separate section for water and for lubricating oil or be arranged for jacket water cooling only.
- 14.2 Belt driven fans shall be provided with at least two belts and the drive shall be capable of transmitting the full load with one belt removed.
- 14.3 Circulation of the jacket water and lubricating oil through the respective radiator sections and/or heat exchanger shall be by means of pumps mechanically driven by the engine. Belt driven pumps shall be provided with at least two belts and the drive shall be capable of transmitting the full load with one belt removed.
- 14.4 An easily visible flow indicator provided with contacts shall be fitted in the water outlet from the engine; the contacts shall close in the 'no-flow' condition and shut down the set.

Alternatively in thermosyphon systems and scaled or pressurised radiator systems the flow indicator may be dispensed with providing the engine shuts down by the operation of the high temperature or low oil pressure safety devices in accordance with Section 22.1.

- 14.5 A thermostatically controlled diverter valve shall be inserted in the engine water discharge pipe with a return to the circulating pump section, to maintain the circulating water at the optimum temperature irrespective of load. Alternatively a thermostatic by-pass will be accepted.
- 14.6 A radiator makeup/expansion tank, fitted with float control inlet shall be provided. If a sealed or pressurised unit is offered the tank may be dispensed with.
- 14.7 Where indicated in Schedule 1 provision shall be made on the radiator framework to permit the attachment of ducting for the discharged air.
- 14.8 A thermometer shall be mounted near the cylinder head(s) to indicate water temperature. Where a lubricating oil cooler is fitted, inlet thermometers shall be mounted at the oil to and outlet from the engine. Alternatively, thermocouples may be provided at all thermometer positions and taken out to an instrument panel.
- 14.9 Adequate drains shall be provided at low points in the water and lubricating oil systems of the radiator and, where applicable, of the heat exchanger.

#### **15. ALTERNATOR AND EXCITER**

- 15.1 The alternator shall be directly coupled to the engine and be sized such that it will accept the maximum output of the engine including overload.
- 15.2 Where the alternator is of the rotating armature type a slipring shall be provided for the neutral.
- 15.3 The alternator shall be capable of operating within the range of  $\pm$  5% of the nominal voltage according to the setting of the automatic voltage regulator.
- 15.4 Three-phase machines shall be star connected, and a diagram showing the terminal markings and phase rotation shall be provided in the terminal box. Cables connecting the machine winding and machine terminals shall not have a higher derating factor for temperature than the windings.
- 15.5 Machines shall be both clean protected and drip proof. Overall drip proof covers will be accepted.

- 15.6 The insulation shall comply with BS 2757 excluding Classes Y and A. The insulation shall have an oil, moisture and fungus proof finish, with a surface which will not retain dust or condensation, it shall be possible to put the set in service after long periods, in unheated storage without the necessity for drying up the insulation.
- 15.7 The alternator shall be capable of withstanding a short circuit for three seconds when under the control of the automatic voltage regulator.

#### 16. **EXCITATION**

Alternators using exciters with commutators shall be designed for an excitation voltage of full load of not less than 50 volts unless prior approval is given.

- 16.2 Where rotary exciters are fitted they may be direct coupled or driven by Vee-belts or chains. The speed of belt or chain driven exciters shall not be within 5% of a multiple of the alternator speed. Vee belt drive shall have at least two belts and shall operate satisfactorily if one belt is removed. Special attention shall be given to ensure satisfactory commutation, brush life and freedom from voltage drift. The neutral and running, positions of the brushes shall be clearly marked.
- 16.3 If static excitation and/or control system are offered, a description of the equipment and method of operation shall be submitted for approval.

#### 17. ELECTRICAL CONTROL PANELS

A control panel shall be provided to accommodate the following:

- 1) An automatic voltage regulator
- 2) A hand field regulator and a 'HAND AUTO' switch
- 3) An alternator field switch
- 4) Meters (Section 21)
- 5) A neutral earthing link
- 6) A change over Contactor

#### **18.** AUTOMATIC VOLTAGE REGULATOR

The automatic voltage regulator shall be of a type which will maintain its adjustment for long period without attention. It shall be provided with an adjustment for setting the level of the controlled voltage to within  $\pm$  5% of the nominal voltage.

#### **19. HAND FIELD REGULATOR**

19.1 The hand field regulator shall give stable control of the voltage from 90% of the normal voltage at no load when cold to normal voltage at 10% over-load when hot, under the specified operating conditions.

If a static excitation system is offered which does not permit the use of a hand field regulator this shall be stated in the Tender together with performance details.

19.2 If the hand field regulator must be left in a precise position when the set is under the control of the automatic voltage regulator then this position shall be clearly marked.

#### 20. METERS

The following meters shall be provided. They shall comply with BS.89, Table 7.

- 1) One maximum demand ammeter in each line
- 2) One voltmeter, and a selector switch to read line to line and line to neutral voltages.
- 3) A frequency meter
- 4) A field ammeter
- 5) Maximum KVA meter and Kilowatt hour meter.

#### 21. AUTOMATIC STARTING PANEL

- 21.1 Automatic starting panel shall be provided which shall contain all necessary equipment for controlling the automatic starting and stopping of the set, lubricating oil priming (if necessary), auxiliaries, fault warnings and shut-downs. All faults, warnings and shut-downs shall be separately indicated. There shall be test facilities for indication lamps etc., preferably by means of a single test button.
- 21.2 Means shall be provided for isolating all supplies to the starting panel either by an isolating switch or by withdrawable fuses. For external use, a 24 volt battery supply from fused outlet terminals shall be provided only when the engine is running and in service (see Section 28.3).
- 21.3 The starting and control circuits shall be rated at 2 amps at the control circuit voltage.
- 21.4 A selector switch shall be fitted having three positions as follows:
  - 1) <u>'Local'</u> In this position it shall be possible to start and stop the set by push buttons mounted on the panel.
  - 2) <u>'Remote'</u> In this position the set shall be capable of being started and stopped from a remote circuit.
  - 3) '<u>Off</u>' In this position all the automatic features shall be inoperative.
- 21.5 When the set is stopped other than under lock-out conditions it shall be self resetting, ready for the next start.
- 21.6 In the 'Off' position (Section 2.4 (3)) or with the automatic equipment disconnected, the set shall be suitable for starting by manual means, e.g. by cranking or direct operation of the starter solenoid.
- 21.7 All switches and push buttons shall be clearly marked to indicate their function.
- 21.8 It shall be possible to operate the "Start and Stop" buttons and the three-position switch and to see the "Set Failure" indications without opening the panel doors.

#### 22. AUTOMATIC CHANGEOVER CONTACTOR UNIT

22.1 Where the functional requirements (see Section 6) indicate the set is to be used for automatic standby or mains failure duty a contactor unit shall be provided which on failure of the normal electricity supply will automatically initiate the starting of and effect the transfer of load to the standby generator.

The unit shall be incorporated in the Automatic Starting Panel (see Section 21).

- 22.2 Where failure of the normal supply is referred to, it shall be defined as the complete loss of voltage or the falling below 85% of the normal voltage between any two lines or line and neutral.
- 22.3 The power circuit shall consist of two contactors feeding the distribution branch to which the load will be directly connected. One contactor shall control the normal supply, the other the standby supply, they shall be electrically and mechanically interlocked so that they cannot both be closed at the same time.

- 22.4 On the failure of the normal supply (Section 22.2) the unit shall operate in the following manner:-
  - 1) After a delay, adjustable from 0 to 5 seconds (to avoid operation by a transient dip in voltage) a signal shall be given to start the standby generating set.
  - 2) On receipt of a signal from the standby generating set that it is ready to take the load, and providing that the failure of the normal supply still persists, the normal supply contactors shall open and the standby contactor shall close. If the normal supply has been restored before the changeover has taken place, the contactors shall not operate and the starting relay contacts shall open to initiate the shutting down of the standby generating set.)
- 22.5 When the standby supply is in operation and the normal supply is restored and remains within 10% of rated voltage on all phases for a pre-set time (adjustable upto to 30 seconds) the standby contactor shall open and the normal supply contactor shall close; the starting relay contacts shall then open to shut down the standby generating set.
- 22.6 Provision shall be made so that automatic return to normal supply can be prevented if required (Section 22.9 (s).
- 22.7 Once a start signal has been sent to the standby generating set the engine starting sequence shall be allowed to continue until the set is ready to take the load before a stopping signal is sent.
- 22.8 By the additional external connections the following facilities shall be available:-
  - 1) Remote starting of the standby generating set and transfer of the load to it.
  - 2) Restoration of the normal supply on failure of the standby generating set.
- 22.9 Each switch shall be labelled with its duty and each position shall be marked. The following switches shall be provided and fitted:-
  - 1) <u>A Contactor Control Switch</u> with make before break contacts and 'Hand' and 'Auto' positions. In the 'Hand' position the unit shall be controlled by the 'Contactor Hand Control Switch' (Section 23.9 (2). In the 'Auto' position the unit shall operate automatically irrespective of the position of the 'Contactor Hand Control Switch'.
  - 2) <u>A Contactor Hand Control Switch</u> with 'Standby' and 'Normal' positions. This switch shall enable either contactor to be closed when the 'Contactor Control Switch' is in the 'Hand' position.
  - 3) <u>An Auto Return Switch</u> having 'On' and 'Off' positions. In the 'On' position the return to normal supply shall be automatic when the normal supply is restored. In the 'Off' position the standby supply contactor shall remain closed when the normal supply is restored.
  - 4) <u>Contactor By-Pass Switches</u> shall be provided to enable the essential load circuits to be served direct from the normal supply to enable the generator and/or the control equipment to be serviced. The by-pass switches shall be provided with a suitable and conspicuous label warning against leaving the generator in the disconnected position.
- 22.10 Indicating lamps or illuminated panels shall be provided on the front of the panel. They shall be appropriately labelled, easily visible and shall give the following information:

'Normal Supply Available' 'Standby Supply Available' 'Normal Supply in Use' 'Standby Supply in Use'

- 22.11 A push button labelled 'Test' shall be provided to enable a failure of normal supply to be simulated. If the button is pressed and released the equipment shall complete the starting sequence, and when the set is ready to take load it shall be shut down. If the button is held depressed the equipment shall change over to the standy supply when the set is ready to take load.
- 22.12 The control circuit supply will be either 12 volts d.c. or 24 volts d.c. depending upon the starting battery and charger (see section 28).

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

#### 23. LOCK-OUT

- 23.1 The set shall stop and lock out to prevent further starting when:
- 1) It fails to start when the electric starter motor has been in operation for 20 seconds under automatic start conditions;
- 2) The lubricating oil pressure falls to a value at which it would be unsafe to continue running the engine;
- 3) The cooling water does not flow, where the engine is fitted with a visible flow indicator on the cooling water system.
- 4) a) in water cooled engines the cooling water temperature exceeds a predetermined limit
  - b) in air cooled engines the cylinder head temperature exceeds a safe maximum
- 5) The overspeed trip has operated.
- 23.2 Failure of the circuits concerned in sub-sections 23.1(2) to 23.1(5) shall not cause a set to shut down.

#### 24. FAULT INDICATION

Each lock-out detailed in Section 23.1 shall be indicated by a lamp on the panel together with an indication of the fault causing the shut-down. The fault warning lights shall be set to operate before the lock-out.

#### 25. LOCK-OUT REMOTE INDICATION CIRCUIT

Where indicated in Schedule 1, an auxiliary circuit suitable for 2 amps 50 volts d.c. and 1 amp 250 volts a.c. shall be provided with a contact which is open when the set is available and closed when it is locked-out. This lock-out circuit shall be connected to terminals for the connection of external wires to provide remote indication of lock-out.

#### 26. LOCK-OUT RESET

Reset of the lock-out shall be by hand.

#### 27. FIRE SERVICE TERMINALS

- 27.1 Where indicated in Schedule 1 an emergency stop circuit shall be provided with terminals marked FS1 and FS2. These terminals shall be initially fitted with a link and are for optional connection to a remote fire switch. Opening of this circuit shall stop the set if it is running, and as long as the circuit remains open the set shall be incapable of being started by 'Hand' or 'Automatic' control. This circuit shall be self-resetting so that the set is available for automatic starting when the circuit is restored.
- 27.2 Terminals shall be provided in the battery circuit for optional connection to a fire service battery switch. Opening of this switch shall isolate the control circuits from their supply.

#### 28. STARTING BATTERY AND CHARGER

28.1 The battery shall be either 12 or 24 volts and capable of withstanding the loads imposed upon it by its specified duties. It may be of lead-acid or alkaline type and shall be of sufficient capacity for four starts in succession once in an eight-hour period. Auxiliary circuits connected to the battery shall be protected by fuses.

- 28.2 The battery shall be used to supply any automatic starting and control equipment, and relay operation shall not be impaired when the battery is supplying current to the starter motor.
- 28.3 A single phase supply for battery charging shall be available from the set when it is in service, and where circumstances permit, from an external supply (Section 17(9).

A charger shall be provided which will recharge the battery after engine starting and maintain it in a charged condition when the set is standing or is in service. It shall also supply the load of any automatic starting and control equipment, and any additional load upto 24 volts level when the set is running and in service. An alternative quick charge rate shall be provided. The charger shall be fitted with an ammeter to measure the charge and discharge current excluding the starter motor current.

#### 9. WIRING

Power cables and small wiring cables interconnecting major components shall be of the heat and oil resistant type and shall be metal sheathed or run in metal ducts or metal conduit, which shall be flexible where appropriate. All cabling and small wiring shall be coded and terminated with lugs or be soldered; the terminations shall be clearly marked with the numbers and letters of terminals to which they are connected. Terminals shall be numbered or lettered, easily accessible and fitted with individual insulating barriers or adequately spaced barriers shall be fitted to separate control terminals from power wiring terminals.

#### **30 EARTHING AND EARTH FIELD**

- 30.1 All metal work housing electrical equipment shall be bonded to a brass earthing terminal of not less than ISO bolt M10.
- 30.2 Where indicated in Schedule 1 an earth field is to be provided suitable for requirements.

#### 31 CONTACTORS

Contactors shall have magnetic circuits designed for a.c. or d.c. operation and shall be rated in accordance with BS 775 for Uninterrupted Duty and Utilization Category AC4. Four-pole contactors shall be fitted for three-phase equipment and two-pole contactors for single phase equipment. Main and auxiliary contacts shall be silver faced or better.

#### 32 RELAYS

- 32.1 Relays shall preferably be of the sealed type mounted in approved plug-in bases with spring loaded retainers but if this is not practicable they shall be mounted on individual sub-bases and wired so that easy access is obtained to soldered connections. Unsealed relays shall be enclosed in individual or common dust protecting cases.
- 32.2 Time delays, if of the pneumatic type, shall operate on filtered air. The thermal type of time delay relay will not be accepted.

#### 33. FUSES

Fuses shall comply with BS 88, category of duty AC 46, fusing factor class A1. A spare fuse cartridge for each pole shall be mounted inside each equipment.

#### **34. RECTIFIERS AND CAPACITORS**

- 34.1 Rectifiers and capacitors shall be suitable for any transient voltages likely to be encountered during the operation of the equipment and for the internal operating temperature of the enclosures at the specified maximum external ambient temperature.
- 34.2 Electrolytic capacitors will not be accepted unless approved for a specified purpose.

#### 35. ENCLOSURES FOR ELECTRICAL AND CONTROL EQUIPMENT

Enclosures for electrical and control equipment shall be drip proof and dust protecting, with adequate front and rear access as necessary for maintenance and repair. Special attention shall be given to the method of construction and to the mounting of the components to minimize the effect of vibration. Diagrams of connections in durable form shall be mounted inside the enclosures.

#### 36. GUARDING

All live and moving parts shall be adequately guarded to prevent injury to personnel.

#### **37. INFORMATION PLATES**

A non-ferrous metal rating plate shall be fixed on the front of the alternator control panel door, giving the following information:

Continuous output		KVA at 0.8 p.	f.
Voltage	V	-phase - wire	
Frequency	Hz	Speed	rev/min
Control Supply	v.d.c	Maker's Serial Number	
Year of supply			

#### **38. DANGER PLATES**

Since this set is automatically started a reversible plate 400 x 250 mm shall be fixed by screws in a prominent position on each side of the set. One side of the plate shall be blank and painted the same colour as the set; the other side of each plate shall be signal red (BS 2660, colour 0-006) with the following inscription in white.

#### DANGER THIS MACHINE IS AUTOMATICALLY CONTROLLED DO NOT WORK ON IT UNTIL STARTING EQUIPMENT IS ISOLATED OR DISCONNECTED AND CAUTION NOTICES ARE DISPLAYED

#### **39. TROPICALISATION OF COMPONENTS**

All components shall be fully tropicalised and protected against mould growth.

#### 40. FINISH

- 40.1 All ferrous metal works shall be either painted or processed to give a rust proof coating.
- 40.2 Ferrous metal work to be painted shall first be either shot blasted or thoroughly wire brushed to remove all scale and oxide and immediately given one brushed coat or two sprayed coats of primer. After not less than 4 hours, one brushed or two sprayed undercoats followed by one brushed or two sprayed finishing coats of heat and oil resisting quality paint shall be applied.
- 40.3 Successive coats of paint shall be of slightly differing shades. Interior surfaces of electrical equipment enclosures shall be finished white and all external surfaces shall be finished grey (BS 2660, colour 9-097). Engine crank cases shall not be painted internally unless the paint is resistant to the lubricating oil.

#### 41. MAINTENANCE MANUAL

- 41.1 Upon Practical completion of the Works the Sub-Contractor shall furnish to the Engineer four copies of a Maintenance Manual relating to the installation forming part of all of the Works.
- 41.2 The Manual shall contain full operating and maintenance instructions for each item of equipment, plant and apparatus set out in a form dealing systematically with each system. It shall include as may be applicable to the Sub-Contract Works the following and any other items listed in the text of the Specification hereinafter.
  - 1) System Description
  - 2) Plant
  - 3) Valve Operation
  - 4) Switch Operation
  - 5) Procedure of Fault Finding
  - 6) Emergency Procedure
  - 7) Lubrication Requirements
  - 8) Maintenance and Servicing Periods and Procedures
  - 9) Colour coding Legend for all Services
  - 10) Schematic and wiring Diagrams of Plant, Apparatus and switchgear.
  - 11) Record Drawings, true to scale, reduced to International A4 size.
  - 12) Lists of Primary and Secondary Spares.
- 41.3 The Manual is to be specially prepared for the Contract Works, and Manufacturers' standard descriptive literature and plant operating instruction cards will not be accepted for inclusion unless exceptionally approved by the Engineer. The Sub-Contractor shall, however, affix such cards, if suitable, adjacent to plant and apparatus. One spare set of all such cards shall be furnished to the Engineer.
- 41.4 Manuals shall be printed on good quality paper preferably International A4 size and shall have stiff covers of durable material. The maker's name and the rating of the set shall appear on the front covers.

#### 42. DRAWINGS

The Sub-Contractor shall provide to the Architect four sets of the following drawings:-

- 1) Where indicated, a building drawing showing details of cable entries, pipe entries and ducts required, and the exhaust system.
- 2) A general arrangement drawing showing the principal dimension and weight of the set.
- 3) A general arrangement of the diesel engine.
- 4) A general arrangement of the alternator and exciter showing terminal markings, polarity and phase rotation.
- 5) A general arrangement of the electrical control panel(s).
- 6) A schematic and wiring diagram of the electrical control panel(s).

#### 43. WORK TESTS

43.1 The set shall be tested as a unit at the manufacturers works (or else where by agreement) for output and performance generally in accordance with the requirements of BS 649 and BS 2613. The Engineer shall be given adequate notice in writing of the date and time of the works tests and he, or his representative shall if he so desires, he present at such tests and be given all reasonable facilities for his own inspections during the course of the tests. 43.2 Whether or not the Engineer or his representative attends the tests, he shall be furnished by the Sub-Contractor with copies of all relevant test certificates.

#### 44. **COMMISSIONING**

- 44.1 The Sub-Contractor shall include for fully commissioning the set and its control equipment and, for the purpose of the required tests, shall provide all necessary instruments, tools, fuel and lubricating oil.
- 44.2 The following tests and checks as applicable shall be carried out by the Sub-Contractor in the presence of the Architect or his representative.
  - 1) Check that the main frame is level in all directions, Engine and generator shafts are in proper alignment and the vibration absorbing devices are properly installed and located.
  - 2) Check water and sump oil levels and that the water jacket and radiator heaters (if fitted) are in working order.
  - 3) Check the battery electrolyte level and the specific gravity.
  - 4) Examine the containers in which the fuel and lubricating oils were delivered and check that the types and grades of oils are as recommended for the units.
  - 5) Ensure that sufficient fuel oil is in the tank for a two hours test run.
  - 6) Check that all radiator and engine block water drain points are free from sludge and other blockages.
  - 7) Check engine bolts, main drive coupling, valve clearances, fuel pump settings, governor settings, pipe line connections, water hose, exhaust couplings, flexible pipework etc., and where a separate cooling water tank is fitted, that the water level is satisfactory and the ball valve and over flow work.
  - 8) Check all outgoing connections on the generator and at the control panel. All lugs for principal connections shall have clean and bright contact surfaces. A suitable abrasive material shall be used where necessary.
  - 9) Check access panels and doors for proper opening and closing and for the functioning of any interlocks fitted.
  - 10) With the set isolated from the main supply and the selector switch in the 'manual' position, start the engine by means of the 'start' push button and allow it to run upto normal speed. Check that during the time the engine starter motor is in operation, the mains battery charger is automatically switched off to avoid its being overloaded by the reduction in voltage across the battery. Where a battery charging dynamo is fitted, Check that the main battery charger is disconnected by the operation of the auxilliary Sub-Contactor during the time the engine is running.
  - 11) Check instruments and gauges for normal operation and response and that the generator voltage is being maintained within the prescribed limits, making due allowance for no load conditions. Compare the reading of the frequency meter with that of the engine tachometer, where both are fitted.
  - Stop engine by turning selector switch to 'off' position and verify that generator contactor opens at between 95%. and 85% of normal voltage.
    Re-check water and oil levels.

13) Turn selector switch 'to auto' position. Disconnect the sensing circuit supply and check that the set starts, the mains contactor opens, and the generator contactor closes in correct order.

Reconnect the sensing circuit to verify that the Engine stops on the restoration of the mains supply and the contactors operate correctly.

Check voltage sensing and time delays on each phase in turn and also that the push buttons for mains failure simulation and Engine stopping operate correctly.

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

- 14) Operate the necessary isolators and switches to put the set on standby for the essential services network with the selector switch in the 'Auto' position, and using the mains failure simulation push, verify that the set operates correctly with the appropriate time delay for taking up load and that the carrying of the load and its distribution over the three phrases are satisfactory.
- 15) Run the set at various loads for periods totalling at least 30 minutes. Check the voltage and current in each phase in turn and that the voltage and frequency are being maintained within the required limits with large alterations of loads.

Note the rate of charge on the dynamo ammeter with the engine running (if a dynamo is fitted) and the rate of charge on the battery charging ammeter with the engine stopped. Check against manufacturer's recommendation and adjust charging rates if necessary.

- 16) Check the operation of the turbo-charger unit(if fitted) and the colour of the exhaust gas at various loads.
- 17) Check that the various engine safeguards operate satisfactorily.
- 18) Check the vibration absorbing devices for proper operation and that the performance of all flexible connections both mechanical and electrical, are satisfactory.
- 19) When all tests are satisfactory and agreed with the Architect or his representative, the lubricating oil and water levels shall be finally checked, the fuel oil tank replenished and the set left in normal operating order.
- 20) An initial supply of all lubricating oils and greases shall be provided by the Sub-Contractor.
- 21) Additional lubricating oil shall be provided for recharging the engine sump once together with a supply of lubricating oils and greases to cover the normal use and servicing of the set during the 12 months maintenance period referred to in section 47.

#### 45. **SPARE PARTS**

The Sub-Contractor shall submit with his tender a separate priced list of spare parts, including any optional extras which he recommends should be purchased for the set and its control equipment and which are not supplied as standard with the unit.

#### 46. TOOLS

A complete set of tools and general and special testing equipment shall be provided, including grease and oil guns, necessary for the normal maintenance of the set and its controls. The tools shall of the best quality, the spanners being of chromevanadium steel and shall be contained in a suitable robust steel tool box with lid fitted with a lock and two keys. All tools and testing equipment may be used by the Sub-Contractor in the execution of the Contract works but will not be accepted as part of the Contract works unless they are handed over in clean and undamaged condition, in perfect working order and effectively in new condition.

#### 47. MAINTENANCE

- 47.1 The Sub-Contractor shall maintain the complete set and associated control equipment forming the unit for a period of twelve of calender months from the date that the unit is put into commission and regular use.
- 47.2 During the maintenance period, the Sub-Contractor shall at his own expenses:-
  - 1) Make good any defects in the unit and replace any parts that fail or show signs of weakness or undue wear in consequence of faulty design, workmanship or materials on notification of the defect.
  - 2) Visit the site and with all diligence attend to any such defect that arises within 48 hours of receiving notification of the defect.
  - 3) Carry out regular examination and serving of the unit at the intervals laid down by the manufacturer or every three months, whichever is the sooner; the service examination to include all necessary adjustments, greasing, oiling, cleaning changing of lubricating oils to keep the unit in sound and efficient working order.
  - 4) Instruct the maintenance personnel in the proper operation, care and maintenance of the set and it's equipment.
- 47.3 If during the maintenance period the unit is or is likely to be out of use for a period greater that 48 hours, due to the unit or part thereof developing a defect attributable to faulty design, workmanship or materials, or due to neglect of maintenance by the Sub-Contractor, the Sub-Contractor shall at his own expense immediately provide and install on free loan a suitable temporary unit for use until the required repair or replacement has been satisfactorily undertaken and the original set (or its replacement) put into proper working order.
- 47.4 At the end of the twelve months period of maintenance the Sub-Contractor shall (in addition of the normal servicing work) carry out a comprehensive examination and test of the set and its auxiliaries, including the checking of the operation of controls and safeguards, to ensure that the unit is in proper working order and in satisfactory condition for handing over to the client whose representative shall be present at such examination and test.

Signed (as in form	n of Tender)	 	
Name of Sub-Cor	ntractor		
Official Stamp			
Date		 	

**PART E:** 

# TECHNICAL SPECIFICATIONS FOR COMMUNICATIONS SERVICES

### PART G: TECHNICAL SPECIFICATIONS FOR COMMUNICATIONS SERVICES

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#### 1.0 AN OVERVIEW OF 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 multiproduct, 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 that are "office oriented".
- 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 (optional0
  - Telecommunications-Outlet/Connector (TO)
- Backbone Cabling
  - Main Cross-connect (MC)
  - Interbuilding Backbone Cable
  - Intermediate Cross-connect (IC)
  - Intrabuilding Backbone Cable
- Work Area (WA)
- Telecommunications 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 point 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  $\Omega$  unshielded twisted-pair.

2-fiber (duplex) 62.5/125  $\mu$ m or multimode optical fiber 9note: 50/125  $\mu$ m multimode fiber will be allowed in '568-B)

• A minimum of two telecommunications outlets are required for each individual work area.

First outlet:  $100 \Omega$  twisted pair (category 5e is recommended)

Second outlet:  $100 \Omega$  twisted pair.

Two-fiber multimode optical fiber either  $62.5/125 \ \mu m$  or  $50/125 \ \mu m$ .

- One transition point (TP) is allowed between different forms of the same cable type (i.e. where undercarpet cable connects to round cable)
- 50  $\Omega$  coax and 150  $\Omega$  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 (eg. 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 30m (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 crossconnects 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:

 $100~\Omega$  UTP  $150~\Omega$  stp-a  $625/125\mu$  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 (OPEN OFFICE)

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 (<29 m)

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 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

# 5.0 HORIZONTAL DISTANCES OF OPTICAL FIBER LINKS (LONG 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.

#### 6.0 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	<b>Transmission Characteristics</b>	Description
3	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.
4	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
5	Transmission characteristics are specified up to 100 MHz.	Meets applicable ca 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.
5e	Transmission characteristics are specified up to 100 MHz.	Performs to category 5e and additional class D requirements of draft amendment 3 of ISO/IEC 11801, and draft addendum 5 to ANSI/TIA/EIA-568-A. Requirements are specified to an upper frequency limit of 100 MHz. This classification is a superset of 5.
6.	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 5e

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.

Category 6 and 7 industry are currently under development.

7.

#### 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 cycles minimum.
- Backward compatibility and interoperability is 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  $-10^{\circ}$ 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 (ScTP)

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 ScTP cabling.

#### 11.1 ScTP:

- 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  $\Omega$  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  $\Omega$  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  $100 \Omega$  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)

Fully shielded cabling requirements are under development by ISO. Cable and connector specification will extend to at least 600 MHz and are intended to support the pending class F cabling requirements.

#### 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  $\Omega$  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 FIBER 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 –  $62.5/125 \mu m$  multimode (two fibers per outlet). Backbone -  $62.5/125 \mu m$  multimode or singlemode.

 $^{\circ}568$ -B will allow the use of 50/125  $\mu$ m 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 is 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 Intermateability 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 Controllined Onti

## **Centralized Optical Fiber Cabling Guidelines**

This Telecommunications Systems Bulletin (TSB) provides the user with the flexibility of designing an optical fiber cabling systems 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-mateable 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 $\Omega$  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  $100\Omega$  cables is frequency dependent and is specified by the following equation:

Delay (ns/100m)  $\leq 534 + 36/\sqrt{f}$ 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

Corrections and additions to TIA/EIA-568-A

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:

- 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 μm optical fiber cable in the horizontal. TIA/EIA TSB72 Centralized Optical Fiber Cabling Guidelines are also referenced.
- 2. 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.
- 3. Additional text was incorporated into section 10.4.3.4 specifying that the connecting hardware used for  $100\Omega$  UTP cabling shall not result in or contain any transposed (e.g transposition of pairs 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.
- 4. A reference to the TSB67 field test methodologies is added to section 10.6.4
- 5. The 568SC optical fiber connector axial pull off strength requirement was decreased from 22 N (5 lbf) to 19.4 N (4.4 lbf)
- 6. Globally, the word "polarization" was replaced with "polarity".
- 7. The initial contact resistance specified in Annex A for connecting hardware was increased from  $1 \text{ m}\Omega$  to 2.5 m $\Omega$  and the contact resistance measurement method was re-written to be more user-friendly.

8. 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 5 e 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 100Ω Enhanced Category 5 Cabling.

<sup>5</sup>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 100Ω 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 loss 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 $100\Omega$ 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 compliment 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.

ANSI/TIA/EIA-568-A (and addenda) Commercial Building Telecommunications Cabling Standard ISO/IEC 11801 (and amendments) Generic Cabling for Customer Premises

## 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,  $100 \Omega$  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.

Dont's:

- 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

#### **18.4 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 top 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 storing slack for the horizontal cables.

- 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:
- 1) Standard NEMA opening (NEMA OS 1 (Ref D. 14), WD-6 (Ref D. 15))
- 2) 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 kPA (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 is 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 are 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 are 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.

# PART F:

# **TECHNICAL SPECIFICATIONS**

# FOR PASSENGER LIFT INSTALLATIONS

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#### PART H: TECHNICAL SPECIFICATION FOR PASSENGER LIFTS INSTALLATIONS

#### 1.01 EXTENT OF WORK

This Sub-contract shall include for supply of the lift equipment, labour, installation, fixing, connecting, commissioning and delivering up clean and in working order in every detail the following lift installation. The supplier will be liable for installing, setting to work and maintaining for a period of one year after commissioning of the lifts.

QUANTITY	:	One (1)
ТҮРЕ	:	Single Wrap Traction Passenger Lifts, Machine room-less
DOORS		Luxury Car Curved Ceiling 12mm granite finish to match lift lobby (or as specified by Architect) White Skin Car Operating Panel Full Height Mirror on 1 side. Half-height mirror on two sides Round Sectioned hand-rails with bright chrome plating Satin Chrome plated kick panels on the bottom of the cabin panels Stainless steel car door panels and car façade One half button riser with ring illuminated micro-motion sensors. Stainless Steel, Sheaves, 1100mm wide, 2100mm high, Centre Opening, 2 panel
CAPACITY	:	800 Kg, 10 persons
DRIVE	:	Gear-less, VVVF
SPEED	:	1.0 m/s
STARTS/HR	:	180
NUMBER OF STOPS/OPENINGS	:	2/2
NUMBER OF OPENINGS	:	Two openings in line with Shaft
TRAVEL HEIGHT	:	6.3 metres (please verify on site)
OPERATION	:	Simplex.
SPECIAL OPERATION	:	Key operated priority call for emergency use, Automatic re- levelling of lift car, over-load control, Independent Service, Fireman service, Intercom System, Standby power operation., priority travel control, Key operated landing call only at ground floor. Intercom from cabin to security room and reception.
CONTROL	:	Fully software based microprocessor control system.
PLATFORM SIZE	:	Approximately 1600mm wide x 1400mm deep with load weighing. (please re-confirm on site).
РІТ	:	1500mm

OVERHEAD	:	4200mm
COMPENSATION	:	Required.
MACHINERY	:	To be installed inside the lift shaft.
BELTS	:	Flat polyurethane – coated high-tensile grade steel belts to be used instead of conventional steel ropes. (NO ROPES)
POWER	:	415V, 3-phase, 50 Hz.
LANDING BUTTONS	:	1 for intermediate floors, 1 for terminal floors. Buttons to have background LED illumination, plus Braille indication for use by the Blind.
BUFFERS	:	Spring / Rubber.
LEVEL/DIRECTION INDICATOR	:	1 per floor for the car
LANDING DOORS	:	Stainless Steel, satin finish, Two panel centre opening with small frames. 1100mm wide x 2100mm high.
CAR DOORS	:	Stainless Steel centre opening with 1100 mm
DOOR OPERATION	:	Heavy duty, high speed intensive traffic doors with heavy duty Variable Frequency (VF), variable speed digital controls. Fully adjustable door open/close speeds, microprocessor controlled.
		Intelligent speed adjustments to cope with traffic requirements.
DOOR PROTECTION DEVICE	:	Full curtain electronic door re-open device.
CABIN DIMENSIONS (Supplier to indicate)	:	
FLOOR DESIGNATION	:	As per Architects indication.
DRIVE SYSTEM	:	Gearless, AC Variable Voltage Variable Frequency (VVVF), with embedded permanent magnets.
SIGNALS	:	Call acknowledging lights, car position indicators, (in car/main floor), waiting passenger lanterns at all openings and landing position indicators at the first level. Travel continuation indicator at all floors. All indicators to be in Liquid Crystal Display (LCD).
COMMUNICATION	:	3-station intercom units in all cars.
MACHINE LOCATION	:	THERE SHALL BE NO MACHINE ROOM
LIFT SHAFT	:	2200 x 2200 (please verify on site)
GUIDE RAILS	:	Required.
LIGHTING	:	Built in curved skin car operating panel with two fluorescent lights with reflectors in translucent plastic diffuser on one side of the cabin panels.

FLOOR BUTTONS	:	Micro motion with LED ring illumination. Translucent back-bit numbers complete with Braille indication for the visually impaired.
MAIN MOTOR		Gearless design Permanent magnet motors (No brushes) Sealed bearings Maintenance free disk brake Integrated 10cm stainless steel sheave and motor shaft. Digital closed loop motion No oils or grease for lubrication.
CONTROL UNIT	:	Stainless Steel Controllers E-Pac to prevent electronic interference. Digital closed loop VF drive with vector control with digital speed encorder.
CAR OPERATING PANEL	:	1 per car fitted on the side panel. To be complete with the following: electro-luminescent back-lit button, micro- motion buttons, intercom speaker, audio/visual overload, keyswitch for fan, keyswitch for lights.
LANDING FIXTURES	:	Wide angle view combined hall position indicators with signal hall lanterns in high resolution LCD on ground floor. Elegantly designed hall buttons with ring illumination.
OTHERS		Three station intercom system. (Car, reception, security room). Compact Disc Music in car. (Wiring only, music by others). Speaker micro-phone built in car operating panel. Speech synthesis. Door open button. Door close button. Forced ventilation key switch Floor levelling guaranteed <u>+</u> 3mm. Independent service key switch. Emergency fire service. Quite-operation, drought-frree multi-directional cabin extract fan. Audio/Visual car overload indication device. Powerful quiet, drought free mutti-directional cabin extract fan. Electronic Reverse Phase Relay built in controller. Siren type emergency alarm system.
POWER SUPPLY	:	Mains 3 phase / 50 Hz Lighting 1 phase – 240 v
FLOOR LEVELLING	:	<u>+</u> 3mm guaranteed
HEAT DISSIPATION	:	0.7 KJ/S
CODE COMPLIANCE	:	European Code EN 81 or British Standard Specification Equivalent (BS5655)
MOTOR RATING	:	Kw
STARTING CURRENT	:	Amps

NOMINAL CURRENT	:	Amps
SHEAVE	:	Stainless Steel
MISCELLANEOUS	:	Heat sensor in the machine room and controller to shut the car as its safety levels at the next landing.
	:	Rescue operation during power failure with emergency and inspection panel, to move the car to the next landing in event of power failure.
	:	Electronic light ray device and infrared curtain on car doors.
	:	Door lock monitoring to put the car on inspection when safety circuits malfunction.
CODE COMPLIANCE STANDARD	:	European Code EN 81. BS 5655 / EN 81
COUNTER WEIGHT	:	Required.

Immediately after appointment the sub-contractor shall provide to the Engineer a general arrangement drawing showing important dimensions and weights of the lifts, and submit colour samples for the Engineer's approval.

The sub-contractor must provide all beams, brackets and fixing devices for fixing of guide rails, counter weights, buffers, door frames, architraves etc.

All fixing devices to be cast in or cut into structural walls shall be supplied and fixed by the subcontractor. It is the responsibility of the sub-contractor alone to ensure that such devices are cast in or otherwise fixed in the right position and in a proper manner.

Partitions in the lift well shall be made in steel net or wire mesh, fixed to concrete beams to be supplied and installed by the sub-contractor.

## 1.02 WORK BY OTHERS

Excluded from this sub-contract is lighting in the plant room and the electrical power supply which shall be brought up to an isolator and distribution board in the plant room by others.

Connection to machinery and for lighting in cars shall be carried out by the lift sub-contractor.

#### 1.03 OPERATION

The car shall travel at a maximum speed of 1.0m/s in all floors.

The car must not start unless the car doors are in a closed position and all landing doors are locked in a closed position.

Should the load on the car exceed the maximum load, the car and landing doors are to be prevented from closing.

Car levelling shall be within 12mm by means of an automatic self-levelling device.

An emergency stop button in the car shall stop the car completely even after the button is released. Re-starting shall take place only by activation of a push button in the car and not by a call from any landing.

Terminal limit switches must stop the car automatically at the terminal landings.

Final limit switches must cut off power and apply the brake automatically, should the car pass the terminal landings.

The installation must be provided with a complete controller device to control starting, stopping and speed as well as emergency stopping of the car in case any of the safety devices do not operate or excessive descending or ascending speed is attained by cutting off power to the motor and activation of the brake.

Calls in the car must be given preference over calls from landings.

At ground floor, calls shall be by means of a key operated switch only for authorised people.

The car must deal with calls in sequence and not be intercepted during their trips by additional calls from cars or landings.

The lift must be provided with automatic bypass devices to prevent unnecessary stops when the cars are full.

The car must not stop during the "up" trip at any landing in response to a "down" landing call, unless this call is the highest one registered.

For inspection purpose a manually operated switch on the controller connected to "up" and "down" direction buttons exposed on the top of the car, must be provided. This switch must permit the car to be operated at slow speed from the top of the car. During this inspection the car must not respond to any calls.

#### 1.04 CAR

The car frame which supports the car platform and enclosure shall be made of solid structural steel with welded, bolted or riveted joints. Bolts used must be positioned for easy adjustment.

Car finishes shall be :-

FLOOR FINISH	:	12mm granite finish to match lift lobby floor finish to architects approval. Other preferred finishes may be substituted.
REAR – WALLS	:	Full height mirror.
HANDRAIL	:	On 3 walls to be satin finished stainless steel rail and brackets.
SIDE WALLS	:	Half-size mirror.
CAR DOORS	:	Stainless Steel, satin finish.
LANDING DOORS	:	Stainless Steel, satin finish.
CEILING	:	To be removable diffuser set. In anodized or painted aluminium frame. Diffuser to be white honey comb plastic. To be fitted with silent exhausts fan yielding approximately 650 m <sup>3</sup> /hr. Alternative ceiling finishes may be suggested by the Architect. Allow for any additional costs.
LIGHTING	:	2 No. LED Panels or as specified by the architect.

The colour and type of finishes shall be approved by the Architect before ordering.

The operating panel in all car must comprise :

. Floor buttons, one of each floor served

. Emergency call button

- . Car inspection switch
- . Emergency stop button

The car shall have direction of travel indicators at high level opposite doors.

The car shall also be equipped with a digital floor position indicator above the sliding doors.

All lamps, buttons, etc., must be changeable from within the car.

All material used shall be approved by the local fire authority.

A load plate shall also be fitted in the car showing the maximum load allowed, in kilograms and number of passengers.

#### 1.05 DOORS AND ARCHITRAVES

The entrance to the car to be provided with two panel automatic centre opening stainless steel, satin finished sliding doors, guided at the bottom by non-metallic shoes sliding in suitable grooves. Doors are to be installed both in car and landings. The doors must be complete with electronic mechanical interlock and emergency opening key.

The car must be stopped and prevented from moving should a door be forced open.

The car doors and the landing doors must open automatically when levelling, the opening to start as the car is approximately 250mm from the landing. The car door and landing door to move simultaneously in opening and closing, being 5 seconds (to be adjustable). In open position the doors automatically have to move back to locked position, even if the car is stationary at the landing. By means of sensitive edge and one photocell the doors have to stop and reverse during their closing cycle if obstructed.

All door panels in landings and cars (like all walls) to be made from materials described earlier. All architraves to be made from spray painted matt finish steel. All plugs, brackets, etc., for architrave-fixing to be provided by the sub-contractor, and cast in by the sub-contractor. The appearance of the cabin will have to be approved by the Architect before ordering.

It is emphasized that great importance is attached to silent functioning of the doors.

#### 1.06 LANDING CALL BUTTONS

At each mid-landing, two stainless steel flush-mounted panels, per car, with two push or touch buttons for "up" and "down" traffic shall be provided between the landing doors. The buttons must light up when a call is registered.

Direction arrow lights shall be incorporated in all landing call panels, arranged so that when a button is pressed the corresponding arrow will illuminate indicating the direction of the call which is registered.

At terminal landings one button only to be installed in each landing panel.

At ground floor two illuminated digital car travel position indicators with arrows shall be placed, one above each door.

#### 1.07 SHAFT INSTALLATIONS

Guide rails for cars and counterweights to be T-steel guide rails planed on three edges. Rails must be placed accurately and fixed firmly to the shaft walls with sufficient spacing between brackets. The rails shall be brought totally to the bottom of the shaft.

The fixing of rails and the connection between two or more sections of rail must be in such a manner that the straight and vertical position is not influenced by changes in temperature or ordinary settlement in the structure.

Guide rails for the car to be either rubber roller guides or Telfon (Tufnol). Roller and shoes shall be renewable.

Buffer must be provided to bring the car counterweight to rest at the extreme limits of travel, should the car for any reason pass the limit switches.

The guide rails, roller shoes, buffers, counter-weight all to be provided and installed by the Subcontractor.

#### 1.08 LIFTING MACHINERY

The machine shall be gearless, single wrap traction type, mounted on steel beams fitted on the shaft walls. The beams to be as per structural engineers details.

The following information on the machinery must accompany the tender.

Make Size, h.p. Voltage, V Power consumption at full load, KW Revolutions per minute, r.p.m. Full load current, A Starting current, A Duration of starting current, sec Power factor,  $\cos \theta$ Acceleration time, sec Retardation time, sec

The motor must be provided with overload and phase failure cutout devices.

The control system to be fitted with a special batter/charger to enable technicians to move cabin to the nearest level to release trapped passengers in case of power failure. The system must prevent engaging of the turning device, until the power supply for the motor is switched off.

The aggregate must be dimensioned for the full load in continuous operation and for a temporary overload of 10%. The sub-contractor must provide information on the highest permissible operating temperature for optional functioning of the lift, and about the heat produced by the entire installation.

#### 1.09 ROPES AND SHEAVES

The lifts shall be provided with durable, flat polyurethane-coated high-tensile steel belts.

The sheaves shall be of ample diameter for ropes used. Sheaves shall be fixed by means of iron beams which are supplied and installed by the sub-contractor. Beams must be sound insulated from structural parts.

#### 1.10 ELECTRICAL INSTALLATION

All motors and switchgear shall be rated for operation at 240V/415V, 50 cycles. Relays and components must be tropicalised.

The installation must comply with the IEE Regulations. All wiring shall be carried out in a neat and orderly manner. Cables run on walls or ceilings to be in straight line and right angle bends enclosed in steel ducting.

Connections to equipment more than 400mm from wall shall be run from the wall in conduit cast in the floor to a connector box fixed upright adjacent to the equipment and through flexible conduit to the equipment.

All electrical switchgear must be clearly labelled.

#### 1.11 ALARM

An alarm button in the car shall simultaneously activate a bell situated on the car and bell positioned at the security station near the lift lobby at ground floor. The bells shall be supplied with power from a rechargeable dry cell battery supplied by sub-contractor. All wiring and installation of the alarm system shall be done by the sub-contractor.

#### 1.12 CONTROL AND DISPLAY SYSTEM

A control and display system shall be provided at the security room. The system, comprising a colour video monitor and keyboard shall indicate real-time elevator status, passenger traffic and demand, etc. It shall also be possible to feed commands to the controller from the keyboard, to adjust operation of the cars and for faults diagnosis.

#### TECHNICAL DETAILS OF LIFTS OFFERED BY THE TENDERER

#### 1. Lifting Machinery

- a) Make
- b) Size, h.p.
- c) Power consumption at full load, KW
- d) Revolutions per minute, r.p.m.
- e) Full load current, A
- f) Starting current, A
- g) Duration of starting current, sec
- h) Power factor,  $\cos \theta$
- i) Acceleration time, sec
- j) Retardation time, sec

## 2. Delivery Details

Time in weeks from acceptance of tender to delivery of all equipment on site \_\_\_\_\_ Weeks.

Time in weeks from acceptance of tender to installation and commissioning \_\_\_\_\_\_ Weeks.

#### **3.** Deviations from the Specification

The Tenderer shall give below details of any Specification, or any deviations, omissions, additions of alternatives in respect of the lifts which he is offering.

If none, write None.

#### **MAINTENANCE CONTRACT**

The Tenderer shall insert in this section the cost of a fully comprehensive Maintenance Contract after one of the initial 12 months maintenance or defects liability period. The sum to be inclusive of regular monthly inspection and breakdown service, and shall include for all tools, parts replacement and service material such as oils, lubricants, etc.

#### ITEM

KSHS.

Annual Maintenance cost for 2 No. lifts as described in the following pages inclusive of all spares and 24 hour call services (start date assumed end of building contract).

#### WARRANTY

The warranty period for the equipment and all the associated accessories shall be \_\_\_\_\_ months from the date of commissioning. (A minimum of 12 months will be allowed).

#### **FOREIGN CURRENCY**

State the foreign currency applied and the exchange rate to the Kenya Shilling.

1 \_\_\_\_\_ (Foreign Currency) = \_\_\_\_\_ KSh.

# PART G:

# PARTICULAR AND TECHNICAL SPECIFICATIONS FOR CCTV INSTALLATIONS

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1.5.2	VIDEO MONITORS
1.5.3	COLOUR VIDEO RECORDERS
1.5.4	CABLES AND CONNECTORS.
1.5.5	UN1NTERRUPTIBLE POWER SUPPLY

#### PARTICULAR SPECIFICATIONS OF MATERIALS AND WORKS

#### I.I Location of site

The location of the proposed works is in Ola karia - Naivasha

#### 1.2 Extent of the Works

The works to be carried out include the supply, delivery, installation, testing, commissioning and leaving in servicing condition the Closed Circuit TV network systems for the premises as described in this specification. The works shall include, but not limited to the supply and installation of the following:-

- Digital Signal Processing Camera
- Colour TV Monitors
- Colour Digital Multiplexing Network Video Recorder
- Colour printers for enhancing picture evidence of an event in a specific area under surveillance.

The CCTV shall cover the following areas

- Entrances/Exits
- Ware House
- All External Areas

#### 1.3 Regulation and Standard

The works shall comply with the provisions of the following as necessary and relevant:

Electric Power Act Kenya Bureau of Standards (K.E.B.S) Institution of Electrical Engineers (LE.E) Wiring Regulations Current recommendation of CCITT and CC1R

#### 1.4 ELECTRICAL REQUIREMENTS

The equipment to be supplied shall be capable of being operated from 240V AC 50Hz power supply.

#### 1.5 TECHNICAL SPECIFICATIONS FOR CLOSED CIRCUIT COLOUR TELEVISION SYSTEM

#### 1.5.1 Fixed Colour Digital Television Cameras

Fixed type colour television cameras shall be located and installed in selected areas as indicated in **clause 1.5.1.2** of this section. They shall be linked to the Television Monitors and the Control Equipment through data points.

The mounting height and position of cameras shall be such that the desired coverage shall be achieved as distinctly as possible.

The digital signal processing (DSP) camera shall be aesthetically styled. The DSP chip will enable advanced video processing and manipulation to be carried out in the camera head. The camera shall be capable of operating at all times, i.e 24 hours a day.

#### 1.5.1.1 Technical Specifications

The works to be carried out include the supply, delivery, installation, testing, commissioning and leaving in servicing condition the Closed Circuit TV network as herein described in this specification. The works shall include, but not limited to the supply and installation of the following:-

- Fixed Color Digital Signal Processing Camera
- Color TV Monitors
- Color Network Video Recording multiplexer

The Digital Surveillance system shall support the following:-

- Digital based recording system
- Support IP cameras through video servers adapters
- Recording resolution: 2032 x 1920 pixels at 8.0fps for J-PEG, M-PEG and wavelet images.
- Multi-sreaming
- Multi-level password protection and logging facilities
- Integrates with access control, burglar control, burglar alarms and fire alarm system
- Image compression for remote web live and playback viewing
- Multi display monitors
- Automatic daily archiving to hard drive or optical drive.
- Fully adjustable digital video motion detection with exclusion /inclusion multi regions per camera.
- Efficient video collection, storage and retrieval.
- Advanced and instant search capability
- Digitally signed recordings, with audit trails of all operator actions and system event.
- At least one Terabyte storage space to provide back up and redundancy
- Infra red illuminators in poor lighting conditions
- Able to interface with other systems on the ground
- Support various alarm and subnet options including VSAT, IP, GSM/GPRS and Radio.
- Network protocol and Services: TCP,UDP,HTTP,HTTPS,DHCP,PPPoE,RTP,RTSP,IPv6,DNS,DDNS,NTP,ICMP,ARP,I GMP,SMTP,FTP,UPnP,SNMP,Bonjour
- Approvals: Minimum CE,FCC

#### 1.5.1.2 DAY/NIGHT, WDR, COLOUR MOTORISED CCD PTZ DOME CAMERA

The **high resolution Camera** shall meet or exceed the following design and performance specifications:-

1.	Image Sensor	1/4-inch
2.	Scanning System	2:1 interlaced output
2	Effective Divela	DAI 724 V 592

3. Effective Pixels PAL – 724 X 582

- 4. Horizontal Resolution PAL >550 TVL
- 5. Lens F1.6 (f=3.6-82.8 mm optical, 23X optical zoom, 10X electronic zoom)
- 6. Programmable Zoom Speeds 2.9, 4.2, or 5.8 seconds
- Horizontal Angle of View 54° at 3.6 mm wide zoom 2.5° at 82.8 mm telephoto zoom
- 8. Focus Automatic with manual override.
- 9. Sensitivity at 35 IRE PAL, color: 0.08 lux at 1/1.5 sec shutter speed B-W: 0.013 lux at 1/1.5 sec shutter speed
  B-W: 0.3 lux at 1/50 sec shutter speed
- 10. Synchronization System Internal/AC line lock phase adjustable via remote control, V-sync
- 11. White Balance Automatic with manual override
- 12. Shutter Speed PAL 1/1.5 1/30,000
- 13. Iris Control Automatic with manual override
- 14. Gain Control Automatic/ off
- 15. Video Output 1 volt peak to peak, 75 ohms
- 16. Video Signal-to-Noise >50 dB
- 17. Type of Lighting Menu selection of indoor or outdoor lighting for optimum camera performance
- 18. Wide Dynamic Range 80X
- 19. Motion Detection User-definable motion detection settings for each preset scene; can activate auxiliary outputs; three sensitivity levels per zone

#### 1.5.1.3 Dome type Video color camera

Type:	Varifocal Fixed Dome.
Lens sensor:	1/3" with Thermal capability
Signal system:	PAL Standard.
Lens focal length	4-9mm DD F 1.6-2.4
Line resolution	480 TV Lines
Backlight Compensation	on/off switch
Maximum illumination	1.2 Lux
Video output	1 V peak-peak PAL compatible
Shutter speed	Automatic, I/60 to 1/100,000s
Tolerance	Bright tolerant with minimum blooming and transfer smear
White balance:	Automatic.
Operational temperature	-10°C to -45°C
ATW range Signal to Nose ratio: Auto Gain Control: Aperture correction:	3000K – 9000K More than 50 dB On 32dB, off 8dB Horizontal and vertical

Contrast: Shall feature automatic white balance capable of adjusting for variations in scene lighting for consistent time colors from one scene to the other.

Picture quality: The picture produced shall have minimum lag and image Retention.

A continual adjustment feature to facilitate C or CS mount lenses will be incorporated, together

with a side mount plug for direct drive Lenses and screw terminals for auto iris lenses.
The camera shall be capable of being line locked with phase adjustment.

Contained under a flap will be a bank of switches which will enable the selection of the following features:

- Electronic iris · AGC on/off
- Back light compensation
- Gamma correction select between 0.45 and 1.0

#### 1.5.1.4 External view (EXview) Video color camera

Type: Lens sensor: Line resolution Signal system: Maximum illumination Video output Shutter speed Tolerance: Signal to Nose ratio: Auto Gain Control: Aperture correction: Contrast:	Solid state color coupled charged device (CCD) I/3" Interline image format with Thermal capability 480 TV Lines. PAL Standard. 0.5 Lux 1 V peak-peak PAL compatible Automatic, I/60 to 1/100,000s Bright tolerant with minimum blooming and transfer smear. More than 50 dB On 32dB, off 8dB Horizontal and vertical Shall feature automatic white balance capable of adjusting for variations in scene lighting for consistent time colors from one scene to the other.
Picture quality:	The picture produced shall have minimum lag and image Retention. A continual adjustment feature to facilitate C or CS mount lenses will be incorporated, together with a side mount plug for direct drive Lenses and screw terminals for auto iris lenses. The camera shall be capable of being line locked with phase adjustment. Contained under a flap will be a bank of switches which will enable the selection of the following features:

- Electronic iris · AGC on/off
- Back light compensation
- Gamma correction select between 0.45 and 1.0

#### 1.5.1.5 PTZ Color Camera

- 1/4" EXview HAD Interlaced Scan CCD
- Day and night function with mechanical IR cut filter
- Thermal Capability
- Minimum illumination 0.01 lux at F1.6
- 36x optical zoom
- 25/30 fps at full D1 resolution
- Selectable H.264, MPEG-4 SP, MJPEG compressions
- with dual streaming

- Two-way audio
- Video motion detection
- Digital input and digital output
- Wide Dynamic Range
- Analog video output with 650 TVL
- Weatherproof IP66 rated casing

#### 1.5.1.6 Lens

The lens shall:be glass optical vertical 1/3" format with direct driver operation. Have a standard CS mount. Have variable focal length of between 4mm and 9 mm and aperture of F 1.6 - 2.4

#### 1.5.1.7 Mounting Brackets

The Brackets shall: Be suitable for wall or ceiling mounting of a single camera. Be at least 5.5"length Have an auto lock facility.

#### 1.5.1.8 Camera Housing

The camera housing shall: Be IP66 rated with integral cable management. Be Weatherproof. Be constructed from aluminium with epoxy coating.

#### 1.5.2 VIDEO MONITORS

The monitor shall be capable of providing high levels of picture quality 10MHz bars visible at low brightness and reliability stable synchronization, black level clamping, low sensitivity and high stability.

The monitors shall be high performance color video monitors for monitoring scenes from the above cameras and viewing playback scenes from the video cassette recorders. The monitors shall be located at places shown on the drawings.

The monitor shall give stable and interference free pictures of scenes being viewed. It shall also conform to the following specifications:

•	Color system	PAL
•	Screen size	25"
•	Resolution	Minimum of 550 TV Lines
•	Video input signal	1.0 V pk-pk
•	Power consumption	Not more than 75W
•	Power input	240V 50HZ

The unit will be dual standard and be capable of using audio and SVHS in. Full loop through connectors to be provided and monitor to have a metal enclosure for reduced RF interference.

#### 1.5.3 COLOUR NETWORK VIDEO MULTIPLEXING RECORDER

The multiplexing recorder shall be used to record events from the Surveillance TV cameras. It shall have the following

- a) a high performance video multiplexer and digital video recorder.
- b) Operate, record, playback and multi-screen viewing with at least 50 PPS.
- With a wave reader software. c)
- d) Provide multi user remote access including remote control of fully functional cameras.

#### The multiplexing recorder shall have the following minimum requirements:-

- Ethernet: 10BaseT/100BaseT supplied complete with wave reader software. 0
- Should be rack mounted for security 0
- Shall feature time base correction, eliminating the need for external camera 0 synchronization.
- Have an Internal CD-writer for archiving purposes 0
- Recording:- Automatic Priority Control, Interleaved or exclusive, or none; Programmable 0
- (Video Motion Detection)VMD Zones Per camera : 256,16x16 grid. 0
- : Full, PIP, Quad, 6, 9, 16 way. Multi screen Display 0 :16
- **Camera** Inputs 0
- Fully multitasking simultaneous recording whilst playing back 0
- To incorporate four removable hard disk drives, allowing upto 3 months storage at 24-0 hour record rates S-VHS quality without additional equipment.
- Alarm handling inputs 16 N/O or N/C 0
- Hard disk capacity of 12TB expandable to 14TB using 250 0
- GB HDD'S 0
- 2 RS485 ports. 0
- Resolution:  $700(h) \ge 550(v)$ 0
- Time and Date display 0
- False alarm rejection: 3 levels 0
- Power supply: 240 V AC, 50 HZ. 0

#### 1.5.4 **CABLES AND CONNNECTORS**

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 UTP cables. The positions for connectors and the equipments shall be directed and identified by the Engineer 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.

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

#### **1.5.5 UNINTERRUPTIBLE POWER SUPPLY (UPS)**

This shall be an on-line Un-interruptible power supply, single-phase supply for every building. It shall provide power to the security surveillance system in case of power failure and/or maintained power failure for a minimum period of 8 hours.

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:	240VAC50HZ
Power factor:	0.7 lag at full load
Current limit:	125% of the normal
Output voltage:	240V AC 50 HZ
Output voltage tolerance:	2%
Output frequency tolerance	: 0.05%

### BILL NO. 1 – LECTURE ROOMS AND ADMINISTRATION BLOCK

1A – GROUND FLOOR INSTALLATIONS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.				(KSh. Cts.)	(Ksh Cts.)
	Supply, install, test, commission and set to work the following. All lighting fittings to be complete with lamp, control gear etc as applicable.				
1a.1	Lighting				
1a.1.1	Lighting point 1-way switched.	90	No.		
1a.1.2	Lighting point 2-way switched.	78	No.		
1a.1.3	5 A white moulded switch plates as MK or Crabtree: -				
	(a) 1-gang 1-way	42	No.		
	(b) 1-gang 2-way	12	No.		
	(c) 2-gang 1-way	8	No.		
	(d) 2-gang 2-way	8	No.		
	(e) 1-gang intermediate	4	No.		
1a.1.4	Install permanent "DANGER" 415V labels where groups of switches have been fed by more than one phase.	4	No.		
1a.1.5	Lighting fittings, complete with lamps of specified wattage and appropriate colour rendering: -				
1a.1.5a)	600x600mm 4x18W HPF fully recessed fluorescent fitting with highly polished reflectors and lourvres as THORN Cat No EFQTS 418, or approved equivalent.	72	No.		
1a.1.5b)	As item No. 1a.1.5 (a) above but emergency version as THORN Cat No EFQTS 418.E, or approved equivalent.	25	No.		
1a.1.5c)	160mm diameter fully recessed downlighter as THORN Corsa160T Cat No COR160 2H126 Cat2, or approved equivalent.	35	No.		
1a.1.5d)	Circular luminaire with die cast aluminium star burst base and thin bazel in white with opal polycarbonate diffuser complete with 28W 2D lamp as Thorn Lyric	4	No.		
1a.1.5e)	2 x 58 W HPF fluorescent batten fitting as Thorn PP 258 or approved equivalent.	2	No.		
1a.1.5f)	100W surface mounted Tungsten bulkhead fitting as Thorn Cat. No. OLG 1100, or approved equivalent, complete with a PL 26 "White" lamp.	20	No.		
1a.1.5g)	8W maintained Exit Emergency Light as Thorn Cat. No. EFVM3/ICEL, or approved equivalent. Minimum 3-hour autonomy.	10	No.		
	Total C/F to Page J/11				

#### **BILL NO. 1 – LECTURE ROOMS AND ADMINISTRATION BLOCK 1A – GROUND FLOOR INSTALLATIONS**

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/10				-
1a.1.5h)	470 x 500 mm wall mounted cityscape opal sphere fitting complete with bracket and 26W PL Law, Type P3 on the drawings as per details shown.	20	No.		
1a.1.5i)	16W 2D shallow plastic light fitting as Thorn super club Cat. No. 2D CL16W complete with lamp	20	No.		
1a.2.0	<u>Communication</u>				
1a.2.1	Dual RJ45 line jack unit for use with Cat 6E cable in trunking and conduits.	60	No.		
1a.2.2	450 x 450 x 200 mm 14 gauge galvanized compartment telephone draw box complete with 3- cover, screws etc.	20	No.		
1a.3.0	<u>Power Supply</u>				
1a.3.0a)	10-way TP/N power distribution board complete with 125A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Schneider or approved equivalent.	1	No.		
1a.3.0b)	As above but 8 Ways for clean line	1	No.		
1a.3.0c)	12-way SP/N power Consumer Unit complete with 100A SP integral isolator and all accessories including lockable cover. The Consumer Unit to be as Schneider or or approved equivalent.	4	No.		
1a.3.1d)	4C 25mm <sup>2</sup> PVC/SWA/PVC cable, copper	120	m.		
1a.3.1e)	3C 10mm <sup>2</sup> PVC/SWA/PVC cable, copper	100	m.		
1a.3.1f)	Cable glands for the above	12	No.		
1a.3.1g)	Cable lugs for the above, complete with hydraulic crimping	12	No.		
1a.3.2h)	SP MCB for the above boards.	96	No.		
1a.3.2i)	TP MCB in the boards above.	2	No.		
1a.3.2j)	Blanking plates for un-used spare ways.	4	No.		
1a.3.2k)	Earthing for the boards above.		Lot		
	Total C/F to Page J/12				

#### ITEM DESCRIPTION QTY UNIT RATE AMOUNT NO. (Ksh Cts.) Total B/F from Page J/11 1a.3.3. Outlet point for fan and hand drier comprising 20mm diameter conduit, wiring in 3 x 4.0 mm<sup>2</sup> SC-PVC-CU cables and all 6 No. accessories including 20A DP switch with neon light as MK or Crabtree. 1a.4.1 200 x 50mm 3-compartment angle trunking to details shown, in 14-gauge galvanized steel sheet with cream powder coating finish 140 m. to approved colour, complete with cover, screws, and all accessories. 1a.4.2 200 x 50mm, factory-made corner-bends for the above trunking, 36 No. in same material and colour finish. 1a.4.3 Carry out bonding throughout the entire length of the above Item trunking in 6mm<sup>2</sup> green PVC insulated copper cable. 1a.4.4 Twin-outlet plates on the trunking, same colour finish 60 No. 1a.4.5a) Punched outlet plates on the trunking for data/telephone outlets. 60 No 1a.4.5b) Data/telephone outlet in 25mm dia conduits 175 No 1a.4.6a) Twin 13A coloured standard white socket outlets, with safety shutters on both live and neutral and with neon light for computer power supply, complete with wiring in 3x2.5mm<sup>2</sup> PVC-SC-CU 60 No cables inside the trunking. The socket outlets to be complete with unbreakable 13A fused non standard top plugs 1a.4.6b) Additional non-standard top plugs for clients keeping 20 No Supply and install 5mm high permanent red trafollyte labels 1a.4.6c) 60 No marked "UPS ONLY" for clean line power sockets Total C/F to Page J/13

#### BILL NO. 1 – LECTURE ROOMS AND ADMINISTRATION BLOCK 1A – GROUND FLOOR INSTALLATIONS

# BILL NO. 1 – LECTURE ROOMS AND ADMINISTRATION BLOCK

1A – GROUND FLOOR INSTALLATIONS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/12				
1a.4.7	Power pedestals complete with 4 No. twin normal socket outlets wiring in 6x2.5mm <sup>2</sup> PVC-SC-PVC cables, 4 No. twin nonstandard socket outlets for computer points with neon lights wiring in radial 3x2.5mm2 PVC-SC-PVC cables and 4 No. telephone/data outlet plates	10	No		
1a.4.8	Twin standard 13A-socket outlet for normal power, wired in 6 x 2.5mm <sup>2</sup> SC-PVC-CU cables inside concealed conduits.	30	No.		
1a.4.9	As above but on trunking	30	No.		
1a.4.10	Co-axial insulated TV outlet point complete with plate, and draw- wire.	10	No		
1a.4.11	Dia. 32mm HG PVC conduits buried in floor slab.	400	m.		
1a.4.12	Outlet for security installations and CCTV installation, comprising box, concealed conduit and all accessories.	20	No.		
1a.5.13	Outlet for fire alarm points comprising concealed PVC conduit, box, wiring in 3 x 1.5mm <sup>2</sup> screened fire-proof cable as FIREPIX or approved equivalent, and all accessories.	82	No		
1a.5.14a)	Outlet for air conditioning unit comprising box concealed, HG PVC conduit, wiring in 3x4mm <sup>2</sup> SC-PVC-CU cables and all accessories including 20A DP switch with neon light.	14	No		
1a.5.14b)	30A voltage switch for air-conditioning unit as Sollateck type AVS 30, wired to the A/C unit above	14	No		
	Total for Bill No. 1A – Ground Floor – Lecture And Administ Page For Lecture andAdministration Block.	ration H	Block C	C/F to Summary	

# BILL NO. 1 – LECTURE ROOMS AND ADMINISTRATION BLOCK

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Supply, install, test, commission and set to work the following. All lighting fittings to be complete with lamp, control gear etc as applicable.				
1b.1	Lighting				
1b.1.1	Lighting point 1-way switched.	88	No.		
1b.1.2	Lighting point 2-way switched.	65	No.		
1b.1.3	5 A white moulded switch plates as MK or Crabtree: -				
	(a) 1-gang 1-way	21	No.		
	(b) 1-gang 2-way	8	No.		
	(c) 2-gang 1-way	8	No.		
	(d) 2-gang 2-way	6	No.		
	(e) 1-gang intermediate	4	No.		
1b.1.4	Install permanent "DANGER" 415V labels where groups of switches have been fed by more than one phase.	4	No.		
1b.1.5	Lighting fittings, complete with lamps of specified wattage and appropriate colour rendering: -				
1b.1.5a)	600x600mm 4x18W HPF fully recessed fluorescent fitting with highly polished reflectors and lourvres as THORN Cat No EFQTS 418, or approved equivalent.	72	No.		
1b.1.5b)	As item No. 1b.1.5 (a) above but emergency version as THORN Cat No EFQTS 418.E, or approved equivalent.	34	No		
1b.1.5c)	160mm diameter fully recessed downlighter as THORN Corsa160T Cat No COR160 2H126 Cat2, or approved equivalent.	30	No		
1b.1.5d)	Circular luminaire with die cast aluminium star burst base and thin bazel in white with opal polycarbonate diffuser complete with 28W 2D lamp as Thorn Lyric	7	No		
1b.1.5e)	Dust proof, jet proof, corrosion resistant 2 x 58W 1500mm HPF fluorescent fitting with plastic diffuser to IP 65 as Thorn Cat. No. FNDV 2065	5	No.		
1b.1.5f)	1 x 36 W HPF fluorescent batten fitting complete with angle diffuser as Thorn PPS 136 or approved equivalent.	5	No.		
	Total C/F to Page J/15				

# BILL NO. 1 – LECTURE ROOMS AND ADMINISTRATION BLOCK

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/14				-
1b.1.5g)	1 x 36 W HPF fluorescent batten fitting as Thorn PP 136 or approved equivalent.	1	No.		
1b.1.5h)	100W surface mounted Tungsten bulkhead fitting as Thorn Cat. No. OLG 1100, or approved equivalent, complete with a PL 26 "White" lamp.	1	No.		
1b.1.5i)	8W maintained Exit Emergency Light as Thorn Cat. No. EFVM3/ICEL, or approved equivalent. Minimum 3-hour autonomy.	10	No.		
1b.1.5j)	16W 2D shallow plastic light fitting as Thorn super club Cat. No. 2D CL16W complete with lamp	20	No.		
1b.2.0	Communication				
1b.2.1	Dual RJ45 line jack unit for use with Cat 6E cable in trunking and conduits.	51	No.		
1b.2.2	450 x 450 x 200 mm 14 gauge galvanized compartment telephone draw box complete with 3- cover, screws etc.	3	No		
1b.3.0	Power Supply				
1b.3.0a)	10-way TP/N power distribution board complete with 125A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Crabtree or Multi-9, or approved equivalent.	1	No		
1b.3.0b)	As above but 4 Ways for clean line	1	No		
1b.3.0c)	12-way SP/N Consumer Unit board complete with 100A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Schneider or approved equivalent.	1	No		
1b.3.1a)	4C 35mm <sup>2</sup> PVC/SWA/PVC cable, copper	50	m.		
1b.3.1b)	4C 10mm <sup>2</sup> PVC/SWA/PVC cable, copper	100	m.		
1b.3.1c)	Cable glands for the above	8	No.		
1b.3.1d)	Cable lugs for the above, complete with hydraulic crimping	32	No.		
1b.3.2a)	SP MCB for te above boards.	94	No.		
1b.3.2b)	TP MCB in the boards above.	4	No.		
	Total C/F to Page J/16				

# BILL NO. 1 – LECTURE ROOMS AND ADMINISTRATION BLOCK

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/15				-
1b.3.2c)	Blanking plates for un-used spare ways.	8	No.		
1b.3.2d)	Earthing for the boards above.		Lot		
1b.3.3.	Outlet point for fan and hand drier comprising 20mm diameter conduit, wiring in 3 x 4.0 mm <sup>2</sup> SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree.	6	No		
1b.4.1	200 x 50mm 3-compartment angle trunking to details shown, in 14-gauge galvanized steel sheet with cream powder coating finish to approved colour, complete with cover, screws, and all accessories.	160	m.		
1b.4.2	200 x 50mm, factory-made corner-bends for the above trunking, in same material and colour finish.	32	No.		
1b.4.3	Carry out bonding throughout the entire length of the above trunking in 6mm <sup>2</sup> green PVC insulated copper cable.		Item		
1b.4.4	Twin-outlet plates on the trunking, same colour finish	60	No.		
1b.4.5a)	Punched outlet plates on the trunking for data/telephone outlets.	60	No		
1b.4.5b)	Data/telephone outlet in 25mm dia conduits	29	No		
1b.4.6a)	Twin 13A coloured standard white socket outlets, with safety shutters on both live and neutral and with neon light for computer power supply, complete with wiring in 3x2.5mm <sup>2</sup> PVC-SC-CU cables inside the trunking. The socket outlets to be complete with unbreakable 13A fused non standard top plugs	60	No		
1b.4.6b)	Additional non-standard top plugs for clients keeping	15	No		
1b.4.6c)	Allow for terminating (flexible) computer power cables into non- standard top plugs	1	Item		
1b.4.6d)	Supply and install 5mm high permanent red trafollyte labels marked "UPS ONLY" for clean line power sockets	51	No		
	Total C/F to Page J/17				

# BILL NO. 1 – LECTURE ROOMS AND ADMINISTRATION BLOCK

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT	
NO.					(Ksh Cts.)	
	Total B/F from Page J/16					
1b.4.7	Power pedestals complete with 4 No. twin normal socket outlets wiring in 6x2.5mm <sup>2</sup> PVC-SC-PVC cables, 4 No. twin nonstandard socket outlets for computer points with neon lights wiring in radial 3x2.5mm2 PVC-SC-PVC cables and 4 No. telephone/data outlet plates	10	No			
1b.4.8	Twin standard 13A-socket outlet for normal power, wired in 6 x 2.5mm <sup>2</sup> SC-PVC-CU cables inside concealed conduits.	40	No.			
1b.4.9	As above but on trunking	22	No.			
1b.4.10	Dia. 32mm HG PVC conduits buried in floor slab.	300	m.			
1b.4.11	Outlet for security installations and CCTV installation, comprising box, concealed conduit and all accessories.	10	No.			
1b.5.1	Outlet for fire alarm points comprising concealed PVC conduit, box, wiring in 3 x 1.5mm <sup>2</sup> screened fire-proof cable as FIREPIX or approved equivalent, and all accessories.	38	No			
1b.5.12a)	Outlet for air conditioning unit comprising box concealed, HG PVC conduit, wiring in 3x4mm <sup>2</sup> SC-PVC-CU cables and all accessories including 20A DP switch with neon light.	4	No			
1b.5.12b )	30A voltage switch for air-conditioning unit as Sollateck type AVS 30, wired to the A/C unit above	4	No			
	Total for Bill No. 1B – First Floor – Lecture Rooms and Administration Block C/F to Summary Page for Administration Block					

### SUMMARY PAGE – LECTURE ROOMS AND ADMINISTRATION BLOCK

ITEM NO.	DESCRIPTION	AMOUNT ( Ksh Cts.)
S1.	Total for Ground Floor Installations B/F from Page J/13	-
S2.	Total for First Floor Installations B/F from Page J/17	-
	Total for Bill No. 1 – Lecture rooms and Administration Block C/F to Summary Page	-

# BILL NO. 2 – LABORATORIES AND LECTURE ROOMS

GROUND FLOOR INSTALLATIONS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Supply, install, test, commission and set to work the following. All lighting fittings to be complete with lamp, control gear etc as applicable.				
2a.1	Lighting				
2a.1.1	Lighting point 1-way switched.	127	No.		
2a.1.2	Lighting point 2-way switched.	100	No.		
2a.1.3	5 A white moulded switch plates as MK or Crabtree: -				
	(a) 1-gang 1-way	32	No.		
	(b) 1-gang 2-way	8	No.		
	(c) 2-gang 1-way	8	No.		
	(d) 2-gang 2-way	6	No.		
	(e) 1-gang intermediate	4	No.		
2a.1.4	Install permanent "DANGER" 415V labels where groups of switches have been fed by more than one phase.	4	No.		
2a.1.5	Lighting fittings, complete with lamps of specified wattage and appropriate colour rendering: -				
2a.1.5a)	600x600mm 4x18W HPF fully recessed fluorescent fitting with highly polished reflectors and lourvres as THORN Cat No EFQTS 418, or approved equivalent.	5	No.		
2a.1.5b)	As item No. 1b.1.5 (a) above but emergency version as THORN Cat No EFQTS 418.E, or approved equivalent.	10	No		
2a.1.5c)	160mm diameter fully recessed downlighter as THORN Corsa160T Cat No COR160 2H126 Cat2, or approved equivalent.	10	No		
2a.1.5d)	Circular luminaire with die cast aluminium star burst base and thin bazel in white with opal polycarbonate diffuser complete with 28W 2D lamp as Thorn Lyric	23	No		
2a.1.5e)	Dust proof, jet proof, corrosion resistant 2 x 58W 1500mm HPF fluorescent fitting with plastic diffuser to IP 65 as Thorn Cat. No. FNDV 2065	90	No.		
2a.1.5f)	1 x 36 W HPF fluorescent batten fitting complete with angle diffuser as Thorn PPS 136 or approved equivalent.	5	No.		
2a.1.5g)	1 x 36 W HPF fluorescent batten fitting as Thorn PP 136 or approved equivalent.	1	No.		
	Total C/F to Page J/120				-

### BILL NO. 2 – LABORATORIES AND LECTURE ROOMS

GROUND FLOOR INSTALLATIONS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/19				-
2a.1.5h)	100W surface mounted Tungsten bulkhead fitting as Thorn Cat. No. OLG 1100, or approved equivalent, complete with a PL 26 "White" lamp.	30	No.		
2a.1.5i)	8W maintained Exit Emergency Light as Thorn Cat. No. EFVM3/ICEL, or approved equivalent. Minimum 3-hour autonomy.	20	No.		
2a.1.5j)	16W 2D shallow plastic light fitting as Thorn super club Cat. No. 2D CL16W complete with lamp	10	No.		
2a.2.0	<u>Communication</u>				
2a.2.1	Dual RJ45 line jack unit for use with Cat 6E cable in trunking and conduits.	80	No.		
2a.2.2	450 x 450 x 200 mm 14 gauge galvanized compartment telephone draw box complete with 3- cover, screws etc.	20	No		
2a.3.0					
2a.3.0(a	6-way TP/N power Sub board complete with 500A TP/N integral isolator and all accessories including lockable cover. The Sub Board to be as Schneider or approved equivalent.	1	No		
2a.3.0(b	10-way TP/N power distribution board complete with 125A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Crabtree or Multi-9, or approved equivalent.	6	No		
2a.3.0c)	As above but 4 Ways for clean line	2	No		
2a.3.0d)	12-way SP/N Consumer Unit board complete with 100A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Schneider or approved equivalent.	2	No		
2a.3.1a)	4C 35mm <sup>2</sup> PVC/SWA/PVC cable, copper	80	m.		
2a.3.1a)	4C 25mm <sup>2</sup> PVC/SWA/PVC cable, copper	120	m.		
2a.3.1b)	4C 10mm <sup>2</sup> PVC/SWA/PVC cable, copper	100	m.		
2a.3.1(c	Cable glands for the above	8	No.		
2a.3.1d)	Cable lugs for the above, complete with hydraulic crimping	32	No.		
	Total C/F to Page J/21				-

## BILL NO. 2 – LABORATORIES AND LECTURE ROOMS

GROUND FLOOR INSTALLATIONS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/20				-
2a.3.2a)	SP MCB for te above boards.	94	No.		
2a.3.2b)	TP MCB in the boards above.	4	No.		
2a.3.2c)	Blanking plates for un-used spare ways.	8	No.		
2a.3.2d)	Earthing for the boards above.		Lot		
2a.3.3.	Outlet point for fan and hand drier comprising 20mm diameter conduit, wiring in 3 x 4.0 mm <sup>2</sup> SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree.	6	No		
2a.4.1	200 x 50mm 3-compartment angle trunking to details shown, in 14-gauge galvanized steel sheet with cream powder coating finish to approved colour, complete with cover, screws, and all accessories.	160	m.		
2a.4.2	200 x 50mm, factory-made corner-bends for the above trunking, in same material and colour finish.	32	No.		
2a.4.3	Carry out bonding throughout the entire length of the above trunking in 6mm <sup>2</sup> green PVC insulated copper cable.		Item		
2a.4.4	Twin-outlet plates on the trunking, same colour finish	160	No.		
2a.4.5a)	Punched outlet plates on the trunking for data/telephone outlets.	140	No		
2a.4.5b)	Data/telephone outlet in 25mm dia conduits	18	No		
2a.4.6a)	Twin 13A coloured standard socket outlets, with safety shutters on both live and neutral and with neon light for computer power supply, complete with wiring in 3x2.5mm <sup>2</sup> PVC-SC-CU cables inside the trunking. The socket outlets to be complete with unbreakable 13A fused non standard top plugs	60	No		
2a.4.6b)	Additional non-standard top plugs for clients keeping	15	No		
2a.4.6c)	Allow for terminating (flexible) computer power cables into non- standard top plugs	1	Item		
2a.4.6d)	Supply and install 5mm high permanent red trafollyte labels marked "UPS ONLY" for clean line power sockets	60	No		
	Total C/F to Page J/20				-

#### **BILL NO. 2 – LABORATORIES AND LECTURE ROOMS**

GROUND	FLOOR INSTALLATIONS
ONOUTOD	

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/21				-
2a.4.7	Power pedestals complete with 4 No. twin normal socket outlets wiring in 6x2.5mm <sup>2</sup> PVC-SC-PVC cables, 4 No. twin nonstandard socket outlets for computer points with neon lights wiring in radial 3x2.5mm2 PVC-SC-PVC cables and 4 No. telephone/data outlet plates	10	No		
2a.4.8	Twin standard 13A-socket outlet for normal power, wired in 6 x 2.5mm <sup>2</sup> SC-PVC-CU cables inside concealed conduits.	160	No.		
2a.4.8b)	16 A TPN local isolator as MK or approved equivalent.	12	No.		
2a.4.8c)	32 A TPN local isolator as MK or approved equivalent.	54	No.		
2a.4.8d)	32 A TP/N Nxtop Red Sign Mushroom Head Emergency Stop Button Weatherproof Button Switch 600V with Box for above isolators with 4 core 6mm cables in HG PVC Conduits.	54	No.		
2a.4.9	Outlet for three phase isolators comprising box, concealed 20mm diameter H/G PVC conduit, wiring in 5 x 4.0 mm <sup>2</sup> SC-PVC-CU cables and all accessories including 20A isolator.	54	No		
2a.4.9(b)	20A TPN local isolator as MK or approved equivalent.	12	No.		
2a.4.9©	As above but on trunking	22	No.		
2a.4.10	Dia. 32mm HG PVC conduits buried in floor slab.	300	m.		
2a.4.11	Outlet for security installations and CCTV installation, comprising box, concealed conduit and all accessories.	10	No.		
2a.4.12	Outlet for fire alarm points comprising concealed PVC conduit, box, wiring in 3 x 1.5mm <sup>2</sup> screened fire-proof cable as FIREPIX or approved equivalent, and all accessories.	38	No		
2a.4.13a)	Outlet for air conditioning unit comprising box concealed, HG PVC conduit, wiring in 3x4mm <sup>2</sup> SC-PVC-CU cables and all accessories including 20A DP switch with neon light.	4	No		
2a.4.13b)	30A voltage switch for air-conditioning unit as Sollateck type AVS 30, wired to the A/C unit above	4	No		
	Total for Bill No. 2 – Laboratory Block C/F to Summary Page				-

#### SUMMARY PAGE – LABORATOIES BLOCK

ITEM NO.	DESCRIPTION	AMOUNT ( Ksh Cts.)
S1.	Total for ground Floor Installations B/F from Page J/22	-
	Total for Bill No. 2 – Laboratories Block C/F to Summary Page	-

#### BILL NO. 3 – WORKSHOP GROUND FLOOR INSTALLATIONS

ITEM NO	DESCRIPTION	QTY	UNIT	RATE	AMOUNT (Ksh Cts)
NO.	Supply, install, test, commission and set to work the				(Ksii Cts.)
3.1	Lighting				
3.1.1	Lighting point 1-way switched.	127	No.		
3.1.2	Lighting point 2-way switched.	100	No.		
3.1.3	<ul> <li>5 A white moulded switch plates as MK or Crabtree: -</li> <li>(a) 1-gang 1-way</li> <li>(b) 1-gang 2-way</li> <li>(c) 2-gang 1-way</li> <li>(d) 2-gang 2-way</li> <li>(e) 1-gang intermediate</li> </ul>	5 8 8 6 4	No. No. No. No. No.		
3.1.4	Install permanent "DANGER" 415V labels where groups of	4	No.		
3.1.5	Lighting fittings, complete with lamps of specified wattage				
3.1.5a)	600x600mm 4x18W HPF fully recessed fluorescent fitting with highly polished reflectors and lourvres as THORN Cat No EFQTS 418, or approved equivalent.	5	No.		
3.1.5b)	As item No. 1b.1.5 (a) above but emergency version as THORN Cat No EFQTS 418.E, or approved equivalent.	10	No		
3.1.5d)	Circular luminaire with die cast aluminium star burst base and thin bazel in white with opal polycarbonate diffuser complete with 28W 2D lamp as Thorn Lyric	7	No		
3.1.5e)	Dust proof, jet proof, corrosion resistant 2 x 58W 1500mm HPF	20	No.		
3.1.5f)	1 x 100 W LED High bay lights as Phillips HB20013 or approved equivalent.	8	No.		
3.1.5g)	1 x 36 W HPF fluorescent batten fitting as Thorn PP 136 or approved equivalent.	5	No.		
3.1.5h)	100W Out door surface mounted Tungsten bulkhead fitting as Thorn Cat. No. OLG 1100, or approved equivalent, complete with a PL 26 "White" lamp.	30	No.		
3.1.5i)	8W maintained Exit Emergency Light as Thorn Cat. No. EFVM3/ICEL, or approved equivalent. Minimum 3-hour autonomy.	10	No.		
3.1.5j)	16W 2D shallow plastic light fitting as Thorn super club Cat. No. 2D CL16W complete with lamp	15	No.		
	Total C/F to Page J/25				

### BILL NO. 3 – WORKSHOP

GROUND	FLOOR	INSTAL	LATIONS

ITEM NO	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
1101	Total B/F from Page J/24				
3.2.0	<u>Communication</u>				
3.2.1	Dual RJ45 line jack unit for use with Cat 6E cable in trunking and conduits.	30	No.		
3.2.2	450 x 450 x 200 mm 14 gauge galvanized compartment telephone draw box complete with 3- cover, screws etc.	20	No		
3.3.0	Power Supply				
3.3.0a)	8-way TP/N power Sub board complete with 500A TP/N integral isolator and all accessories including lockable cover. The Sub Board to be as Schneider or approved equivalent.	1	No		
3.3.0a)	10-way TP/N power distribution board complete with 125A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Crabtree or Multi-9, or	9	No		
3.3.0b)	As above but 6 Ways for clean line	1	No		
3.3.0c)	12-way SP/N Consumer Unit board complete with 100A TP/N integral isolator and all accessories including lockable cover. The	4	No		
3.3.1a)	4C 50mm <sup>2</sup> PVC/SWA/PVC cable, copper	50	m.		
3.3.1a)	4C 25mm <sup>2</sup> PVC/SWA/PVC cable, copper	100	m.		
3.3.1a)	4C 16mm <sup>2</sup> PVC/SWA/PVC cable, copper	60	m.		
3.3.1b)	4C 10mm <sup>2</sup> PVC/SWA/PVC cable, copper	100	m.		
3.3.1c)	Cable glands for the above	8	No.		
3.3.1d)	Cable lugs for the above, complete with hydraulic crimping	32	No.		
3.3.2a)	SP MCB for te above boards.	94	No.		
3.3.2b)	TP MCB in the boards above.	4	No.		
	Total C/F to Page 1/26	<u> </u>	8		_

# BILL NO. 3 – WORKSHOP

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.	Total B/F from Page J/25				(Ksh Cts.)
3.3.2c)	Blanking plates for un-used spare ways.	8	No.		
3.3.2d)	Earthing for the boards above.	1	Lot		
3.3.3.	Outlet point for fan and hand drier comprising 20mm diameter	6	No		
3.4.1	200 x 50mm 3-compartment angle trunking to details shown, in	160	m.		
3.4.2	200 x 50mm, factory-made corner-bends for the above trunking,	32	No.		
3.4.3	Carry out bonding throughout the entire length of the above		Item		
3.4.4	Twin-outlet plates on the trunking, same colour finish	36	No.		
3.4.5a)	Punched outlet plates on the trunking for data/telephone outlets.	36	No		
3.4.5b)	Data/telephone outlet in 25mm dia conduits	12	No		
3.4.6a)	Twin 13A coloured standard socket outlets, with safety shutters on both live and neutral and with neon light for computer power supply, complete with wiring in 3x2.5mm <sup>2</sup> PVC-SC-CU cables inside the trunking. The socket outlets to be complete with unbreakable 13A fused non standard top plugs	30	No		
3.4.6b)	Additional non-standard top plugs for clients keeping	15	No		
3.4.6c)	Allow for terminating (flexible) computer power cables into non- standard top plugs	1	Item		
3.4.6d)	Supply and install 5mm high permanent red trafollyte labels marked "UPS ONLY" for clean line power sockets	60	No		
	Total C/F to Page J/27				_

#### BILL NO. 3 – WORKSHOP GROUND FLOOR INSTALLATIONS

ITEM	DESCRIPTION	OTV	UNIT	DATE	AMOUNT
NO.	DESCRIPTION	QIY	UNII	KAIŁ	(Ksh Cts.)
	Total B/F from Page J/26				-
3.4.7	Power pedestals complete with 4 No. twin normal socket outlets	10	No		
3.4.8	Twin standard 13A-socket outlet for normal power, wired in 6 x	30	No.		
3.3.4b)	32 A TPN local isolator as MK or approved equivalent.	30	No.		
3.3.5a)	Outlet for three phase isolators comprising box, concealed 20mm diameter H/G PVC conduit, wiring in 5 x 6.0 mm <sup>2</sup> SC-PVC-CU cables and all accessories including 32A isolator.	30	No		
3.3.5b)	20A TPN local isolator as MK or approved equivalent.	30	No.		
3.4.9	As above but on trunking	22	No.		
3.4.10	Dia. 32mm HG PVC conduits buried in floor slab.	300	m.		
3.4.11	Outlet for security installations and CCTV installation,	10	No.		
3.3.12	Outlet for fire alarm points comprising concealed PVC conduit,	30	No		
1b.3.13a)	Outlet for air conditioning unit comprising box concealed, HG	4	No		
1b.3.13b	30A voltage switch for air-conditioning unit as Sollateck type	4	No		
	Total for Bill No. 3 – Workshops Block C/F to Summary Page	on Pag	e J/28		-

#### SUMMARY PAGE – WORKSHOPS BLOCK

ITEM NO.	DESCRIPTION	AMOUNT (Ksh Cts.)
S1.	Total for ground Floor Installations B/F from Page J/27	-
	Total for Bill No. 3 – Workshop C/F to Summary Page	-

<b>BILL NO 4 – KITCHEN AND DINNING BLOC</b>	K
<b>DILL NO. 4 – KITCHEN AND DIMINING DECC</b>	

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NU.	Supply install test commission and set to work the	┣───	╉────┦		(Ksn Cts.)
4.1	Supply, install, test, commission and set to work the <u>Lighting</u>				
4.1.1	Lighting point 1-way switched.	111	No.		
4.1.2	Lighting point 2-way switched.	91	No.		
4.1.3	<ul> <li>5 A white moulded switch plates as MK or Crabtree: -</li> <li>(a) 1-gang 1-way</li> <li>(b) 1-gang 2-way</li> <li>(c) 2-gang 1-way</li> <li>(d) 2-gang 2-way</li> </ul>	20 8 12 12	No. No. No. No.		
4.1.4	Install permanent "DANGER" 415V labels where groups of switches have been fed by more than one phase.	6	No.		
4.1.5	Lighting fittings, complete with lamps of specified wattage and appropriate colour rendering: -				
4.1.5a)	600x600mm 4x18W HPF fully recessed fluorescent fitting with highly polished reflectors and lourvres as THORN Cat No EFQTS 418, or approved equivalent.	6	No.		
4.1.5b)	As item No. 3.1.5 (a) above but emergency version as THORN Cat No EFQTS 418.E, or approved equivalent.	2	No		
4.1.5c)	160mm diameter fully recessed downlighter as THORN Corsa160T Cat No COR160 2H126 Cat2, or approved equivalent complete with 2 No 26 W lamps.	35	No		
4.1.5d)	Circular luminaire with die cast aluminium star burst base and thin bazel in white with opal polycarbonate diffuser complete with 28W 2D lamp as Thorn Lyric	13	No		
4.1.5e)	1 x 18W HPF fluorescent batten fitting with plastic diffuser as Thorn PPD 118 or approved equivalent.	10	No.		
4.1.5f)	18 W opal glass finished with chrome trim detail decorative wall bracket as Thorn Venette.	14	No.		
4.1.5g)	8W maintained Exit Emergency Light as Thorn Cat. No. EFVM3/ICEL, or approved equivalent. Minimum 3-hour autonomy.	10	No.		
4.1.5h)	470 x 500 mm wall mounted cityscape opal sphere fitting complete with bracket and 26W PL Law, Type P3 on the drawings as per details shown.	12	No.		
4.1.5i)	Corrossion resistant fluorescent range to IP 65/67 2 x 58W HPF fluorescent fitting with acrylic diffuser as Thorn LU Euro Proof.	20	No.		
	Total C/F from Page J/30		<u> </u>		

#### BILL NO. 4 – KITCHEN AND DINNING BLOCK

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/29				-
4.1.5k)	<ul><li>16W 2D shallow plastic light fitting as Thorn super club Cat. No.</li><li>2D CL16W complete with lamp</li></ul>	18	No.		
4.1.51)	Flame Proof fittings for the Kitchen Hood as Thorn DB 80	4	No		
4.2.0	<u>Communication</u>				
4.2.1	Dual RJ45 line jack unit for use with Cat 6E cable in trunking and conduits.	20	No.		
4.2.2	450 x 450 x 200 mm 14 gauge galvanized compartment telephone draw box complete with 3- cover, screws etc.	6	No		
4.3.0	Power Supply				
4.3.1	10-way TP/N power distribution board complete with 100A TP/N integral isolator and all accessories including lockable cover. The Distribution Board to be as Crabtree or Multi-9, or approved equivalent.	1	No		
4.3.1a)	4C 25mm <sup>2</sup> PVC/SWA/PVC cable, copper	75	m.		
4.3.1b)	Cable glands for the cables above	12	No.		
4.3.1c)	Cable lugs for the cables above, complete with hydraulic crimping	48	No.		
4.3.2a)	SP MCB in the above boards.	120	No.		
4.3.2b)	TP MCB in the boards above.	16	No.		
4.3.2c)	Blanking plates for un-used spare ways.	12	No.		
4.3.2d)	Earthing for the boards above.		Lot		
4.3.3.	Outlet point for heater, fan and hand drier comprising 20mm diameter conduit, wiring in 3 x 4.0 mm <sup>2</sup> SC-PVC-CU cables and all accessories including 20A DP switch with neon light as MK or Crabtree.	18	No		
4.3.4b)	16 A TPN local isolator as MK or approved equivalent.	6	No.		
4.3.5a)	Outlet for three phase isolators comprising box, concealed 20mm diameter H/G PVC conduit, wiring in 5 x 4.0 mm <sup>2</sup> SC-PVC-CU cables and all accessories including 20A isolator.	6	No		
4.3.5b)	20A TPN local isolator as MK or approved equivalent.	6	No.		
	Total C/F from Page J/31				

#### BILL NO. 4 – KITCHEN AND DINNING BLOCK

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/30				-
4.3.6a)	Outlet for three phase isolator, comprising box, concealed 20mm diameter H/G PVC conduit, wiring in 5 x 6.0 mm <sup>2</sup> SC-PVC-CU cables and all accessories including 32A isolator.	6	No		
4.3.6b)	32A TPN local isolator as MK or approved equivalent.	6	No.		
4.3.7a)	Outlet for cooker control unit comprising wiring in 3x6.0mm <sup>2</sup> SC- PVC CU cables, twin steel box Dia. 25mm HG PVC conduit link, and all accessories including 45A DP cooker control unit with neon lamp, and 13A integral socket with neon lam as MK or approved equivalent.	6	No.		
4.3.7b)	45A DP cooker connector unit with wiring in 3 x 6.0mm <sup>2</sup> SC- PVC-CU cables, and Dia. 25mm HG conduit link to the above.	6	No.		
4.3.8	Outlet for 15A socket outlet, comprising box, concealed 20mm diameter H/G PVC conduit, wiring in 3 x 4.0 mm <sup>2</sup> SC-PVC-CU cables and all accessories including 15A DP switch with neon light.	8	No		
4.4.1	Twin standard 13A-socket outlet for normal power, wired in 6 x 2.5mm <sup>2</sup> SC-PVC-CU cables inside concealed conduits.	45	No.		
4.4.2	Co-axial insulated TV outlet point complete with plate, and draw- wire.	8	No		
4.4.3	Dia. 32mm HG PVC conduits buried in floor slab.	400	m.		
4.4.4	Outlet for security installations and CCTV installation, comprising box, concealed conduit and all accessories.	8	No.		
4.4.5	Outlet for Piped Music system and TV installation, comprising box, concealed conduit and all accessories.	40	No.		
4.4.6	Outlet for fire alarm points comprising concealed PVC conduit, box, wiring in 3 x $1.5$ mm <sup>2</sup> screened fire-proof cable as FIREPIX or approved equivalent, and all accessories.	50	No		
	Total for Bill No. 4 – Dinning BLOCK C/F to Summary Page	<u> </u>	<u> </u>		-

#### BILL No. 5: HOSTELS

6a) GENTS GROUND FLOOR

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Supply, install, test and commission the following: -				
5a.1	Lighting				
5 . 1 1	Lishting point 1 you switched	51	N-		
Ja.1.1	Lighting point 1-way switched.	54	INO.		
5a.1.2	Lighting point 2-way switched.	39	No.		
5a.1.3	5 A white moulded switch plates as MK, Legrand, Crabtree or				
	approved equivalent -	Q	No		
	(h) $1$ -gang $2$ -way	0 12	No.		
	(c) $2$ -gang 2 way	12	No.		
	(c) 2-gaig 2 way	10	10.		
5a.1.4	Install permanent "DANGER" 415V labels where groups of				
cuiri	switches have been fed by more than one phase.	4	No.		
5a.1.5	Lighting fittings, complete with lamps of specified wattage and				
	appropriate colour rendering: -				
	(a) 160mm diameter fully recessed downlighter as THORN	0			
	corsa1601 Cat No COR160 2H126 Cat2, or approved	8	No.		
	equivalent.				
	(b) 1x36W 1200mm HPF hare batten as THORN Cat No PP136				
	or approved equivalent.	4	No.		
	(c) 2x36W 1200mm HPF bare batten as THORN Cat No PP236				
	or approved equivalent.	4	No		
	(d) 8W maintained Exit Emergency light as Thorn Cat No	6	No		
	EFVM3/ICEL or approved equivalent.	0	INO.		
	(e) Wall mounted Uplighter with silver finish complete with	16	N.		
	2x26W IC-DEL fluorescent lamps as Thorn MRG WALL or	10	NO		
	(f). 16W 2D shallow plastic light fitting as Thorn super club Cat.	15	N.		
	No. 2D CL16W complete with lamp	15	NO		
	(g) 470 x 500 mm wall mounted cityscape opal sphere fitting	32	No		
	complete with bracket and 26 w PL Lamp as per details				
	(h) Table top reading lamp with goose neck complete with 18W	22	ЪT		
	lamp as approved	32	No		
L					
	T-4-1 C/T f 1/22				
	10tal C/r Irom Page J/33				-

#### BILL No. 5: HOSTELS

#### 6a) GENTS GROUND FLOOR

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/32				-
	(i) 13W shaver strip light complete with 110/240V shaver socket and pull cord as Thorn Cat. No. FLST 13.	8	No		
5a.2	<ul> <li>(j) Circular luminaire with die cast aluminium star burst base and thin bazel in white with opal polycarbonate diffuser complete with 28W 2D lamp as Thorn Lyric</li> <li>Power Supply</li> </ul>	20	No		
5a.2.1	32mm diameter HG PVC concealed conduits.	300	m.		
5a.2.2	Dia. 50mm HG conduits in floor slab	100	m.		
5a.2.3	8-way TPN Distribution Board as Merlin Gerlin Crabtree or approved equivalent complete with 125A TPN integral isolator for flush mounting.	1	No.		
5a.2.4(a	SP MCB units for the above	38	No.		
5a.2.4b)	Blanking plates for un-used spare ways	10	No.		
5a.2.5a)	4C 25mm <sup>2</sup> PVC/SWA/PVC, copper cable	30	m.		
5a.2.5b)	Cable glands for the above cable	4	No.		
5a.2.5c)	Labelling of all the final sub-circuits		Item		
5a.2.6a)	Twin standard 13A-socket outlet for normal power, wired in 6 x 2.5mm <sup>2</sup> SC-PVC-CU cables inside concealed conduits.	48	No.		
5a.2.7	Outlet for television co-axial cable comprising concealed HG PVC conduit square PVC box draw wire and TV outlet plate as MK range or approved equivalent.	2	No		
5a.2.8	200 x 200 x 150m galvanized steel draw box in 18-gauge steel.	2	No.		
5a.2.9	Outlet point for Extract fan comprising 20mm diameter conduit, wiring in 3 x 4.0 mm <sup>2</sup> SC-PVC-CU cables and all accessories including 20A DP switch with neon light.	4	No		
5a.2.10	Outlet for security installations and CCTV installation, comprising box, concealed conduit and all accessories.	4	No.		
5a.2.11	Outlet for fire alarm points comprising concealed PVC conduit, box, wiring in 3 x 1.5mm <sup>2</sup> screened fire-proof cable as FIREPIX or approved equivalent, and all accessories.	22	No		
	Total for Bill No. 6a Ground Floor C/F to Summary Page for t Page J/38	the Hos	stels In	stallations on	-

#### BILL No. 5: HOSTELS

6b) FIRST FLOOR

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Supply, install, test and commission the following: -				
5b.1	Lighting				
51 1 1	ren e e e e e				
56.1.1	Lighting point 1-way switched.	146	No.		
5\b.1.2	Lighting point 2-way switched.	76	No.		
``					
5b.1.3	5 A white moulded switch plates as MK, Legrand, Crabtree or				
	approved equivalent -				
	(a) 1-gang 1-way	66	No.		
	(b) 1-gang 2-way	67	No.		
	(c) 2-gang 2 way	4	No.		
56.1.4	Install permanent "DANGER" 415V labels where groups of	4	No.		
	switches have been red by more than one phase.				
5b.1.5	Lighting fittings, complete with lamps of specified wattage and				
	appropriate colour rendering: -				
	(a) 160mm diameter fully recessed downlighter as THORN				
	Corsa160T Cat No COR160 2H126 Cat2, or approved	10	No.		
	equivalent.				
	(b) 2x36W 1200mm HPE bare batten as THORN Cat No PP236				
	or approved equivalent.	4	No		
	(c) 8W maintained Exit Emergency light as Thorn Cat No				
	EFVM3/ICEL or approved equivalent.	6	No.		
	(d) Wall mounted Uplighter with silver finish complete with				
	2x26W TC-DEL fluorescent lamps as Thorn MRG WALL or	32	No		
	approved equivalent.				
	(a) 1 GW 2D at allow allows it is the fitting on Theme are a last. Cat				
	(e) 16W 2D shallow plastic light fitting as 1 norn super club Cat.	32	No		
	No. 2D CETOW complete with famp				
	(f) Circular luminaire with die cast aluminium star burst base and				
	thin bazel in white with opal polycarbonate diffuser complete	20	No		
	with 28W 2D lamp as Thorn Lyric				
	(g) Table top reading lamp with goose neck complete with 18W	32	No		
	lamp as approved				
	(h) 13W shaver strip light complete with 110/240V shaver socket				
	and pull cord as Thorn Cat. No. FLST 13.	10	No		
	Total C/F from Page J/35				-

### BILL No. 5: HOSTELS

#### 6b) TYPICAL FLOOR

ITEM NO	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
110.	Total B/F from Page J/34				(KSII Cts.) -
5b.2	Power Supply				
5b.2.1	32mm diameter HG PVC concealed conduits.	300	m.		
5b.2.2	Dia. 50mm HG conduits in floor slab	100	m.		
5b.2.3	8-way TPN Distribution Board as Merlin Gerlin Crabtree or approved equivalent complete with 125A TPN integral isolator for flush mounting.	2	No.		
5b.2.4a)	SP MCB units for the above	38	No.		
5b.2.4b)	Blanking plates for un-used spare ways	10	No.		
5b.2.5a)	4C 25mm <sup>2</sup> PVC/SWA/PVC, copper cable	80	m.		
5b.2.5b)	Cable glands for the above cable	4	No.		
5b.2.5c)	Labelling of all the final sub-circuits		Item		
5b.2.6a)	Twin standard 13A-socket outlet for normal power, wired in 6 x 2.5mm <sup>2</sup> SC-PVC-CU cables inside concealed conduits.	80	No.		
5b.2.7	Outlet for television co-axial cable comprising concealed HG PVC conduit square PVC box draw wire and TV outlet plate as MK range or approved equivalent.	34	No		
5b.2.8	200 x 200 x 150m galvanized steel draw box in 18-gauge steel.	2	No.		
5b.2.9	Outlet point for Extract fan comprising 20mm diameter conduit, wiring in 3 x 4.0 mm <sup>2</sup> SC-PVC-CU cables and all accessories including 20A DP switch with neon light.	4	No		
5b.2.10	Outlet for security installations and CCTV installation, comprising box, concealed conduit and all accessories.	4	No.		
5b.2.11	Outlet for fire alarm points comprising concealed PVC conduit, box, wiring in 3 x 1.5mm <sup>2</sup> screened fire-proof cable as FIREPIX or approved equivalent, and all accessories.	22	No		
	Total for 1 No First Floor C/F To summary page for Hostels		_		-

#### BILL No. 5: HOSTELS

#### C LADIES GROUND FLOOR

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Supply, install, test and commission the following: -				
5c.1	Lighting				
5c.1.1	Lighting point 1-way switched	39	No		
		57	110.		
5c.1.2	Lighting point 2-way switched.	13	No.		
5c.1.3	5 A white moulded switch plates as MK, Legrand, Crabtree or				
	approved equivalent - (a) 1-gang 1-way	6	No		
	(h) $1$ -gang $2$ -way	8	No.		
	(c) $2 - a a a g 2 way$	4	No.		
	(c) 2-gaing 2 way	4	INO.		
5c.1.4	Install permanent "DANGER" 415V labels where groups of				
	switches have been fed by more than one phase.	4	No.		
	· · · · · · · · · · · · · · · · · · ·				
5c.1.5	Lighting fittings, complete with lamps of specified wattage and				
	appropriate colour rendering: -				
	(a) 2x36W 1200mm HPF bare batten complete with louvres as				
	THORN Cat No PPS236 or approved equivalent.	8	No		
	(b) 8W maintained Exit Emergency light as Thorn Cat No	6	N.		
	EFVM3/ICEL or approved equivalent.	0	INO.		
	(c) 16W 2D shallow plastic light fitting as Thorn super club Cat.	28	No		
	No. 2D CL16W complete with lamp	20	110		
	(d) 1 x 18W HPF fluorescent batten fitting with plastic diffuser as $T_{\rm exp}$ = DDD 110	4	No		
	Thorn PPD 118 or approved equivalent.				
	(a) Circular luminaire with die cast aluminium star burst base and				
	(c) Chediai fulfiliare with the east authinitian star burst base and thin bazel in white with onal polycarbonate diffuser complete	8	No		
	with 28W 2D lamp as Thorn Lyric	0	110		
	1 2				
5c.2	Power Supply				
5c.2.1	32mm diameter HG PVC concealed conduits.	100	m.		
5c.2.2	Dia. 50mm HG conduits in floor slab	100	m.		
5022	9 way TDN Distribution Board on Martin Carlin Crokters on				
30.2.5	8-way IPN Distribution Board as Merini Gernii Crabitee or approved equivalent complete with 125 A TPN integral isolator	1	No		
	for flush mounting	1	140.		
	ist most mounting.				
					-
	Total C/F from Page J/37				
	8				

#### BILL No. 5: HOSTELS

5c)	LADIES	GROUND	FLOOR
50)		UNCOULD	LOOK

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/36				-
5c.2.4a)	SP MCB units for the above	26	No.		
5c.2.4b)	Blanking plates for un-used spare ways	8	No.		
5c.2.5a)	4C 25mm <sup>2</sup> PVC/SWA/PVC, copper cable	40	m.		
5c.2.5b)	Cable glands for the above cable	2	No.		
5c.2.5c)	Labelling of all the final sub-circuits		Item		
5c.2.6a)	Twin standard 13A-socket outlet for normal power, wired in 6 x 2.5mm <sup>2</sup> SC-PVC-CU cables inside concealed conduits.	48	No.		
5c.2.7	Outlet for television co-axial cable comprising concealed HG PVC conduit square PVC box draw wire and TV outlet plate as MK range or approved equivalent.	8	No		
5c.2.8	200 x 200 x 150m galvanized steel draw box in 18-gauge steel.	2	No.		
5c.2.9	Outlet point for Extract fan comprising 20mm diameter conduit, wiring in 3 x 4.0 mm <sup>2</sup> SC-PVC-CU cables and all accessories including 20A DP switch with neon light.	28	No		
5c.2.10	Outlet for security installations and CCTV installation, comprising box, concealed conduit and all accessories.	4	No.		
5c.2.11	Outlet for fire alarm points comprising concealed PVC conduit, box, wiring in 3 x 1.5mm <sup>2</sup> screened fire-proof cable as FIREPIX or approved equivalent, and all accessories.	22	No		
	Total for Bill No. 5c Ladies Ground Floor C/F to Summary Pa on Page J/38	age for	the Ho	stels Installations	

### **HOSTELS**

#### SUMMARY PAGE

ITEM NO.	DESCRIPTION	AMOUNT (Ksh Cts.)
1	Bill No. 6a: Gents Ground Floor Installations B/F from Page J/33	
2	Bill No. 6b: 2 No. Gents First Floor installations B/F from Page J/35	
3	Bill No. 6c: Ladies Ground Floor installations B/F from Page J/37	
4	Bill No. 6d: Ladies First Floor installations B/F from Page J/35	
	Total C/F to Summary Page	

#### BILL No. 6: VILLAS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Supply, install, test and commission the following: -				
6.a	Lighting				
6.1.1	Lighting point 1-way switched.	16	No.		
(1.)					
6.1.2	Lighting point 2-way switched.	76	No.		
613	5 A white moulded switch plates as MK. Legrand. Crabtree or				
0.1.5	approved equivalent -				
	(a) 1-gang 1-way	1	No.		
	(b) 1-gang 2-way	2	No.		
	(c) 2-gang 2 way	2	No.		
6.1.4	Install permanent "DANGER" 415V labels where groups of	1	No.		
	switches have been fed by more than one phase.				
6.1.5	Lighting fittings, complete with lamps of specified wattage and				
0.115	appropriate colour rendering: -				
	(a) 160mm diameter fully recessed downlighter as THORN				
	Corsa160T Cat No COR160 2H126 Cat2, or approved	4	No.		
	equivalent.				
	(b) 2x36W 1200mm HPF bare batten as THORN Cat No PP236 or approved equivalent	1	No		
	(c) 8W maintained Exit Emergency light as Thorn Cat No				
	EFVM3/ICEL or approved equivalent.	1	No.		
	(d) 16W 2D shallow plastic light fitting as Thorn super club Cat.	1	No		
	No. 2D CL16W complete with lamp				
	(e) Circular luminaire with die cast aluminium star burst base and				
	thin bazel in white with opal polycarbonate diffuser complete	2	No		
	with 28W 2D lamp as Thorn Lyric				
	(f) Table top reading lamp with goose neck complete with 18W	1	No		
	lamp as approved	1	110		
	Total C/F from Page J/47				-

#### BILL No. 6: VILLAS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
Γ	Total B/F from Page J/46				-
6.2	Power Supply				
6.2.1	32mm diameter HG PVC concealed conduits.	50	m.		
6.2.2	Dia. 50mm HG conduits in floor slab	50	m.		
6.2.3	6-way TPN Distribution Board as Merlin Gerlin Crabtree or approved equivalent complete with 125A TPN integral isolator for flush mounting.	1	No.		
6.2.3(b	6-way SP Cosnumer Unit as Merlin Gerlin Crabtree or approved equivalent complete with 125A TPN integral isolator for flush	1	No.		
6.2.4(a	SP MCB units for the above	4	No.		
6.2.4(b	Blanking plates for un-used spare ways	3	No.		
6.2.5(a]	3C 15mm <sup>2</sup> PVC/SWA/PVC, copper cable	50	m.		
6.2.5(b	Cable glands for the above cable	4	No.		
6.2.5(c	Labelling of all the final sub-circuits		Item		
6.2.6	Twin standard 13A-socket outlet for normal power, wired in 6 x 2.5mm <sup>2</sup> SC-PVC-CU cables inside concealed conduits.	3	No.		
6.2.7	Outlet for television co-axial cable comprising concealed HG PVC conduit square PVC box draw wire and TV outlet plate as MK range or approved equivalent.	1	No		
6.2.8	200 x 200 x 150m galvanized steel draw box in 18-gauge steel.	2	No.		
6.2.9	Outlet point for Extract fan comprising 20mm diameter conduit, wiring in 3 x 4.0 mm <sup>2</sup> SC-PVC-CU cables and all accessories including 20A DP switch with neon light.	1	No		
6.2.10	Outlet for security installations and CCTV installation, comprising box, concealed conduit and all accessories.	1	No.		
6.2.11	Outlet for fire alarm points comprising concealed PVC conduit, box, wiring in 3 x 1.5mm <sup>2</sup> screened fire-proof cable as FIREPIX or approved equivalent, and all accessories.	1	No		
	Total for 1 No Typical Rooms				
	Total for 8 No Room C/F to Summary Page for the Executive	-			
	Page J/41				

### <u>VILLAS</u> SUMMARY PAGE

ITEM NO.	DESCRIPTION	AMOUNT ( Ksh Cts.)
1	Bill No. 6:Executive Accomodation installations B/F from Page J/40	-
	Total for accomodation units C/F to Summary Page	
### **BILL NO. 7 – POWER ROOM 1A – GROUND FLOOR INSTALLATIONS**

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.		-		(KSh. Cts.)	(Ksh Cts.)
	Supply, install, test, commission and set to work the following. All lighting fittings to be complete with lamp, control gear etc as applicable.				
7.1	Lighting				
7.1.1	Lighting point 1-way switched.	1	No.		
7.1.2	Lighting point 2-way switched.	5	No.		
7.1.3.	5 A white moulded switch plates as MK or Crabtree: - (a) 1-gang 1-way	1	No.		
	(b) 1-gang 2-way	3	No.		
7.1.4	Install permanent "DANGER" 415V labels where groups of switches have been fed by more than one phase.	4	No.		
7.1.5	Lighting fittings, complete with lamps of specified wattage and appropriate colour rendering: -				
7.1.5(a	160mm diameter fully recessed downlighter as THORN Corsa160T Cat No COR160 2H126 Cat2, or approved equivalent.	12	No.		
7.1.5(b	Twin standard 13A-socket outlet for normal power, wired in 6 x 2.5mm <sup>2</sup> SC-PVC-CU cables inside concealed conduits.	12	No.		
7.1.5(c	Dia. 32mm HG PVC conduits buried in floor slab.	40	m.		
7.1.5(d	Outlet for security installations and CCTV installation, comprising box, concealed conduit and all accessories.	5	No.		
7.1.5(e	Outlet for fire alarm points comprising concealed PVC conduit, box, wiring in 3 x 1.5mm <sup>2</sup> screened fire-proof cable as FIREPIX or approved equivalent, and all accessories.	3	No		
7.2	12-way SP/N power Consumer Unit complete with 100A SP integral isolator and all accessories including lockable cover. The Consumer Unit to be as Schneider or or approved equivalent.	1	No.		
7.3	3C 10mm <sup>2</sup> PVC/SWA/PVC cable, copper From the LV board	20	m.		
	Total For 1 No Power RoomC/F to Summary Page				

# BILL NO. 8 – GUARD HOUSE

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.		-		(KSh. Cts.)	(Ksh Cts.)
	Supply, install, test, commission and set to work the following. All lighting fittings to be complete with lamp, control gear etc as applicable.				
8.1	<u>Lighting</u>				
8.1.1	Lighting point 1-way switched.	1	No.		
8.1.2	Lighting point 2-way switched.	5	No.		
8.1.3	5 A white moulded switch plates as MK or Crabtree: -	1	Ŋ		
	(a) 1-gang 1-way	1	No.		
	(b) 1-gang 2-way	2	No.		
8.1.4	Install permanent "DANGER" 415V labels where groups of switches have been fed by more than one phase.	4	No.		
8.1.4(a	Lighting fittings, complete with lamps of specified wattage and appropriate colour rendering: -				
8.1.4(b	Dust proof, jet proof, corrosion resistant 2 x 58W 1500mm HPF fluorescent fitting with plastic diffuser to IP 65 as Thorn Cat. No. FNDV 2065	4	No.		
8.1.5(a	Twin standard 13A-socket outlet for normal power, wired in 6 x 2.5mm <sup>2</sup> SC-PVC-CU cables inside concealed conduits.	12	No.		
8.1.5(b	Dia. 32mm HG PVC conduits buried in floor slab.	48	m.		
8.1.5(c	Outlet for security installations and CCTV installation, comprising box, concealed conduit and all accessories.	10	No.		
8.1.6	Outlet for fire alarm points comprising concealed PVC conduit, box, wiring in 3 x 1.5mm <sup>2</sup> screened fire-proof cable as FIREPIX or approved equivalent, and all accessories.	4	No		
8.2	12-way SP/N power Consumer Unit complete with 100A SP integral isolator and all accessories including lockable cover. The Consumer Unit to be as Schneider or or approved equivalent.	1	No.		
8.2.1	3C 10mm <sup>2</sup> PVC/SWA/PVC cable, copper From the LV board	120	m.		
	Total For Bill No. 8 : Guard House C/F to Summary Page				-

BILL NO.	9 – MAINS	POWER	DISTRIBI	TION
DILL INV.	$\mathcal{I} = 101701100$	TOWER	DISTRIDU	11011

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Supply, install, test, commission and set to work the				
9.01	Free-standing purpose made front access main switchboard				
(a)	Digital multimeter capable of measuring voltage in the range 0 – 1000V, 3-phase, current in the range 0-1000A, 3-phase, and all power system parameters (KW, KVA, KWHr, KVArs, Frequency, P.F., harmonics and all the parameters). The multimeter to have an accessible terminal for connecting an external printer, and should be complete with selector switches for viewing/displaving the various parameters.				
(b)	1 No. 1000A TP MCCB (adjustable in 1000-1200A range) main incomer. The MCCBs to be motorized and have both electrical and mechanical inter-lock.				
(c)	5 No. 1500A TPN insulated copper bus bars of 80 x 10mm cross section.				
(d)	5 No. 250A TPN motorized MCCBs as shown, but adjustable in the range 200–250A				
(e)	2 No. 500A TPN motorized MCCBs as shown, but adjustable in the range 500–600A				
(f)	3 No. 150A TPN MCCB, motorized				
(g)	Sufficient spare capacity for future development all fitted with 3 No. 150A MCCBs				
(h)	An 1000A TPN automatic change-over system, with electrical and mechanical interlock. The change-over contactors to be TELE-MECANIQUE, minimum rating 1000A. A manual by- pass system, rated at 100A TPN should also be provided across the change-over system and it must be capable of by-passing both mains and generator supplies in alternation. All the delay timers for pre-ignition, time to load, and return to mains supply to be provided. An actual setting to be agreed upon before main switchboard is assembled. Clear indicator lamps for "mains available", "mains on load", "generator available", generator on load", together with corresponding permanent labels should also be provided. The change-over and by-pass system to be incorporated in the main switchboard assembly.		Item		
(j)	6mm perspex viewing window				
(k)	Heavy duty rubber lining for all the perspex viewing windows				
(1)	415V three-phase surge diverter as Furse ESP 415, wired as shown, complete with enclosure with viewing window.		Item		
	Total C/F from Page J/45	-			-

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total C/F from Page J/44				-
	(Note: The entire switchboard assembly to be Form 4, Type 2 i.e. totally safe with all live parts completely inaccessible on opening the outside cover)				
9.02	Carry out comprehensive labeling of all the bus bars. CT chambers, circuit breakers etc. of item No. 9.01 and above, indicating the areas served, outgoing cable sizes etc.		Item		
9.03	Comprehensive protective multiple earthing of item No. 9.01 in 1500mm long 12mm diameter pure electrolytic copper earth rod deep driven to permanent moisture level, copper clamp. 70mm <sup>2</sup> green earth lead complete with all accessories. (Note: Use parallel rods if effective earthing cannot be achieved with 1 No. rod).		Item		
9.04	Diameter 150mm HG PVC ducts for external power distribution.	150	m.		
9.05	450 x 450 x 250mm 14-gauge galvanised steel cable draw box, complete with cover, screws etc.	18	No.		
9.06(a	Excavate trenches for the above ducts average depth 700mm, remove soft earth, lay duct, cover with "DANGER – HATARI" tiles, back-fill with soil and compact to natural ground level.	1000	m.		
9.06(b	Allow for micro-tunelling across tarmac roads	20	m.		
9.07	Build 600 x 600 x 700mm deep power manhole complete with internal plaster and heavy duty EAFW steel cover.	34	No.		
9.07(b	As 9.07a) above, but earthing manhole, with cover marked "EARTH"	1	No.		
9.08(a	4C 35mm <sup>2</sup> XLPE/SWA/XLPE copper cable to Administration and LectureBlock	180	m.		
9.08(b	Cable glands for the above cable	8	No		
9.08(c	Cable lugs for the above cable complete with hydraulic crimping	32	No		
	Total C/F from Page J/44				

#### **BILL NO. 9 – MAINS POWER DISTRIBUTION**

#### DESCRIPTION ITEM QTY UNIT RATE AMOUNT NO. (Ksh Cts.) Total C/F from Page J/45 9.09(a 4C 35mm<sup>2</sup> XLPE/SWA/XLPE copper cable to the Laboratories 150 m 9.09(b Cable glands for the above cable 2 No 9.09(c Cable lugs for the above cable complete with hydraulic crimping 8 No 9.10(a 4C 50mm<sup>2</sup> XLPE/SWA/XLPE copper cable to Workshop 100 m. 9.10(b Cable glands for the above cable 2 No 9.10(c Cable lugs for the above cable complete with hydraulic crimping 8 No 9.11(a 4C 35mm<sup>2</sup> XLPE/SWA/XLPE copper cable to Student Kitchen 100 m. and Dining 9.11(b Cable glands for the above cable 2 No Cable lugs for the above cable complete with hydraulic crimping 9.11(c 8 No 9.12(a 4C 35mm<sup>2</sup> XLPE/SWA/XLPE copper cable to Male Students 200 m. Hostels Cable glands for the above cable 9.12(b 2 No 9.12(c Cable lugs for the above cable complete with hydraulic crimping 8 No 9.13(a 4C 35mm<sup>2</sup> XLPE/SWA/XLPE copper cable to Female Students 220 m. Hostels 9.13(b Cable glands for the above cable 2 No 9.13(c Cable lugs for the above cable complete with hydraulic crimping 8 No 9.14(a 4C 35mm<sup>2</sup> XLPE/SWA/XLPE copper cable to Villa 240 m. 9.14(b Cable glands for the above cable 2 No 9.14(c Cable lugs for the above cable complete with hydraulic crimping 8 No Total C/F from Page J/47

#### **BILL NO. 9 – MAINS POWER DISTRIBUTION**

BILL NO.	9 – MAINS	POWER	DISTRIBUTION
DILLING	/	1 O II LIN	DISTRIBUTION

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total C/F from Page J/58				-
9.15	250A TP/N manual by-pass system for the UPS comprising 250A TP/N manual change-over switch, 3 No. 250A TP MCBs at input and output internal wiring and a common firmly bonded metallic enclosure made from 14 gauge cream powder coated galvanised steel sheets.	2	No		
9.16	100A TP/N manual by-pass system for the UPS comprising 100A TP/N manual change-over switch, 3 No. 100A TP MCBs at input and output internal wiring and a common firmly bonded metallic enclosure made from 14 gauge cream powder coated galvanised steel sheets.	2	No		
9.17(a	4C 50mm <sup>2</sup> XLPE/SWA/XPLE copper cable	75	m.		
9.17(b	Cable glands for the above cable	2	No		
9.17(c	Cable lugs for the above cable complete with hydraulic crimping	8	No		
9.18(a	4C 35mm <sup>2</sup> PVC/SWA/PVC copper cable	150	m.		
9.18(b	Cable glands for the above cable	2	No		
9.18(c	Cable lugs for the above cable complete with hydraulic crimping	8	No		
9.18(d	Allow for carrying out comprehensive testing of the installation as per IEE Wiring Regulation, 17 <sup>th</sup> Edition.		Item		
9.19	Carry out very concise load balancing to achieve a maximum imbalance not greater than $\pm$ 10% between any two phases, measured at the main switch.		Item		
	Note: The following to be included with the bid:-				
	1. Detailed shop drawing of the Main switchboard and all the sub switchboards.				
	Total for Bill No. 9: Mains Power Distribution, C/F to Summary Page				-

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Supply, install, test and commission the following:-				
10.00	63A TP MCCB on the supply side of the main 800A TP MCCB main switch.	3	No.		
10.01	Label the above MCCB thus: "SUPPLY TO WATER BOOSTER/HOSE REEL PUMPS: DO NOT SWITCH OFF" in red 10mm higher permanent traffolyte labels.		Item		
10.02(a	Sub mains circuit comprising 4C 35mm <sup>2</sup> PVC/SWA/PVC copper cable from the MCCB to the 4-way TP/N board for water booster/hose reel pumps.	90	m.		
10.02(b	Cable glands for the above cable.	6	m.		
20.02(c	Cable lugs for the above cable.	24	No.		
10.03	6-way TP/N power distribution board in the switch room complete with 100A TP/N integral isolator, the board to be Crabtree or Merlin Gerlin	3	No.		
10.04	32A TP MCB in the board above.	16	No.		
10.05	Label the above MCB's thus "HOSE REEL PUMP 1, HOSE REEL PUMP 2 and WATER BOOSTER PUMP" respectively.		Item		
10.06	Install blanking plates for un-used spare ways	2	No.		
10.07	4-core 10mm <sup>2</sup> PVC/SWA/PVC cables from the MCB's above to the local isolators of the hose reel pumps and fountain pump.	120	m.		
10.08	32A TPN Splash-proof local isolator for hosereel / water booster pumps, as Telemecanique, complete with all accessories.	16	No.		
<u> </u>					
	Total for Bill No. 12: Water Booster / Hose Reel Pumps C/F to	o Sumn	ary Pa	ige	-

#### BILL NO. 12 – INSTALLATION OF WATER BOOSTER PUMP AND HOSE-REEL PUMPS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Supply, install, test, commission and set to work the following:- All fire alarm equipment to be as per relevant KS and BS standards. This fire alarm specification is for a fully addressable analogue system. Supplying a conventional system will lead to automatic disqualification. And due to the sensitivity of this contract, only the specified items to be supplied. Alternatives, will NOT be accepted.				
11.00	Outlet for fire alarm points wired in 3 x 1.5mm <sup>2</sup> screened fire- proof cable as FIREPIX or approved equivalent, and all accessories	350	No.		
11.01	Outlet for fire alarm panels/repeater panels comprising 2A fused unswitched spur outlet, concealed PVC conduit, wiring in 3 x 2.5mm <sup>2</sup> SC-PVC-CU cables.	8	No.		
11.02	Analogue photoelectric smoke detector complete with lockable base and alarm indicator LED. (State make and type).	280	No.		
11.03	Analogue addresseable heat detector complete with lockable base and alarm indicator LED. (State make and type)	20	No.		
11.04	Addressable manual call points complete with monitoring resistor, protective plastic coating on the glass, test key and polycarbonate flap. (State make and type)	38	No.		
11.05	Addressable weatherproof manual call points complete with monitoring resistor, protective plastic coating on the glass, test key and polycarbonate flap. (State make and type)	7	No		
11.06	Addressable electronic loop sounder wired direct onto the detection loop and powered from the loop, suitable for both external and internal application complete with volume control, a choice of 12 different sounds and rated at 85-100 dBA at 1 m. (State make and type). (State make and type).	26	No.		
11.07	Addressable standard interface units (using relays) for connecting detectors in voids, and to serve as remote indicators when detector triggers in the void. (State make and type).	16	No.		
11.08	High efficiency xenon beacons with enhanced optical design for maximum light dissipation and 2W xenon discharge lamp rated IP65. (State make and type).	16	No.		
	Total C/F from Page J/50				-

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/49				-
11.09	Short circuit isolator for protecting a fire detection loop by making sure a short-circuit or an open circuit fault in any zone does not affect other zones. (State make and type).	16	No.		
11.10(a	Four-loop Analogue addressable fire detection and alarm control panel complete with printer, 8 lines 80 character LCD. The control panel to be designed to meet fully the requirements of EN54 Pt. 2 and 4: 1998 and BS 5839 Part 1.				
	The panel to be complete with battery pack and automatic charger for minimum 72-hour operation under conditions of sustained power failure. (State make and type). The main panel to be located in the Main Security office	8	No.		
11.11	Analogue addressable repeater panel, wired to the main panel above, and complete with a 72-hour battery pack and automatic charger, to work in conjunction with the main panel. (State make and type). The repeater panel to be located in Guard Hose at the gate.	8	No.		
11.12(a	Fire Alarm Graphics software complete with a desk top computer and capable of full control of fire alarm system as designed by FIREPIX, or other approved software vendors.	1	No.		
11.12(b	Communications Drive Unit	5	No.		
11.12(c	Serial Communications Interface Unit	5	No.		
11.13	Allow for linking the above main fire alarm panel as dedicated zone on the security alarm panel.		Item		
11.14	Carry out wiring in 3 x 1.5mm <sup>2</sup> in FIRE-RESISTANT, SCREENED cable, all drawn inside the ducts/conduits.	1,200	m.		
	[Note: The cable must be FIRE-RESISTANT and not merely heat resistant. This has to be demonstrated at presentation of sample]				
	Total for Bill No. 11: Internal Fire Detection and Alarm Insta				

### BILL NO. 11: INTERNAL FIRE DETECTION AND ALARM INSTALLATIONS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Supply, install, test, commission and set to work the following:				
12.01	Solar Powered Security lights type P, in long "diminishing" octagonal steel sections, varying from 300mm "diameter" at base to 100mm at the top, complete with SON 150W "soft yellow" high-efficiency, high-output sodium street lights with fixtures, glass cover, and control gear. Price to include 12m high twin-arm pole as per details shown, the complete fitting, and all fixing accessories.	35	No.		
12.02	6m long twin-arm octagonal-section steel pole in 4mm zinc-scope sized steel sheets, buried 2m deep, and rising 10m above ground level, as per details shown.	35	No.		
12.03	Excavate holes to take the poles in item no. 13.08 above, minimum hole diameter, 1.5m, minimum depth 2m, install pole, back-fill with grade 20 concrete, cover with soil, and backfill to neutral ground level.	35	No.		
12.04	Earthing for each alternative pole	35	No.		
12.05	Lucy-cut-out in each pole, complete with 2A HRC fuse.	35	No.		
12.06	Football pitch lighting consisting of 12 m lighting tower burried 1m deep complete with 6 No High efficiency Solar Powered LM6 aluminium floodlight with polycarbonate front and internal control gear for 250W (internal ignitor) HP – $E/1$ lamp and sealed to IP 65 as Thorn SonPAK 7, or approved equivalent. The tower to be as per details shown	1	No		
12.07	150W Flood light as Thorn SONPARK	4	No.		
12.08(a	New floor mounted external Solar Powered street lighting pillar in 12 meters Long 14 gauge galvanized steel sheets with green stove enamelled paint, complete with 20A TPN contactor as Telemecanique, 5A photocell unit, 100A SP by-pass switch, all wired in 3x6mm <sup>2</sup> SC-PVC-CU cables, 10A SP MCCB's, 3 No. blanking plates, complete with comprehensive labelling, and PME to KPLC Standards	30	No.		
12.09	Mounting, testing snd commisioning	1	Item		
	Total for Bill No. 12: External Lighting C/F to Summary Page				

#### **BILL NO. 12 – EXTERNAL LIGHTING**

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Note: All lightning protection products to be FURSE – Alternative makes will NOT be accepted.				
13.1	Air Termination				
13.1.1	15mm diameter multiple point copper air terminal as Furse Cat. No. RA 600.	12	No.		
13.1.2	Copper air terminal base as Furse Cat. No. SD 105.	12	No.		
13.1.3	Copper junction clamps for tape.	54	No.		
13.1.4	25 x 3mm turned copper tape as Furse Cat. No. TC 230.	600	m.		
13.1.5	Copper ridge saddle as Furse Cat. No. CD 115.	54	No.		
13.1.6	D.C. tape clip as Furse Cat. No.CP 210.	40	No.		
13.1.7	Copper rod-to-tape coupling.	28	No.		
13.2	Down Conductors				
13.2.1	25 x 3mm turned copper tape as Furse Cat. No. TC 230.	860	m.		
13.2.2	D.C. tape clip as Furse Cat. No. CP 210.	180	No.		
13.2.3	Oblong test/junction clamp as Furse Cat. No. CN 105.	14	No.		
13.2.4	Diameter 38mm HG PVC conduits for the down conductors above.	600	m.		
13.3	Earth Termination				
13.3.1	15mm diameter, 1200mm long solid copper earth rod as Furse Cat. No. RC 020, complete with driving stud and spike.	25	No.		
13.3.2	Earth rod-to-tape clamp type A.	25	No.		
13.3.3	Concrete inspection earth pit Cat. No. PT 005 with 5 hole earth bar as Furse Cat. No. PT 006.	25	No.		
13.3.4	1500mm x 1500mm copper earth mat made from 25mm x 3mm copper tape at 300mm spacing, buried at permanent moisture level and complete with all clamps, welding joints and 6m long 25mm x 3mm insulated copper tape clamped to the down conductors.	25	No.		
	Total for C/F to Page J/53				-

RILL	NO	13_	LIGHTNING	PROTE	CTION AND	<b>PILOT</b>	LIGHTING
DILL	110.	13 -	LIGHTNING	INOIE	CHON ANI		

### BILL NO. 13 – LIGHTNING PROTECTION AND PILOT LIGHTING

ITEM NO.	DESCRIPTION	QTY	UNIT	RATE	AMOUNT ( Ksh Cts.)
	Total B/F from Page J/52				-
13.4	Bonding				
13.4.1	Bonding and clamping to all metal work including water pipes, gas pipes, hand-rails, air-conditioning units, window frames, cladding, metal roof etc. and the main earth for the building.		Item		
	Total for Bill No. 13 –Lightning Protection and Pilot Lighting				

				-	
				( Ksh	Cts.)
Supply, install, test, commission and set to work the following:					
Build 630 x 450 x 700mm deep standard Telkom Kenya telephone manhole complete with internal plaster and heavy duty EAFW steel cover.	20	No.			
100mm diameter HG PVC duct.	2200	m			
As above but with concrete surround	100	m			
75mm diameter HG PVC duct.	600	m			
Install 6mm <sup>2</sup> SC-PVC-cable draw wire inside the above duct.	2200	m			
Excavate trenches for duct above, average depth 700mm, remove soft earth, lay ducts, backfill with soil and compact to natural ground level.	1400	m			
Allow for micro-tunnelling across tarmac roads	60	m			
Total for Bill No. 14: Communication Distribution Ducting C/F to Summary Page					
	Solid States and the second states are s	Dilowing:       20         Build 630 x 450 x 700mm deep standard Telkom Kenya       20         Edephone manhole complete with internal plaster and heavy duty       20         EAFW steel cover.       200         00mm diameter HG PVC duct.       200         Sa above but with concrete surround       100         5mm diameter HG PVC duct.       600         nstall 6mm <sup>2</sup> SC-PVC-cable draw wire inside the above duct.       2200         Excavate trenches for duct above, average depth 700mm, remove oft earth, lay ducts, backfill with soil and compact to natural round level.       1400         Allow for micro-tunnelling across tarmac roads       60         Cotal for Bill No. 14: Communication Distribution Ducting Z/F to Summary Page       50	Build 630 x 450 x 700mm deep standard Telkom Kenya       20       No.         Build 630 x 450 x 700mm deep standard Telkom Kenya       20       No.         SAFW steel cover.       200       m         00mm diameter HG PVC duct.       2200       m         As above but with concrete surround       100       m         '5mm diameter HG PVC duct.       600       m         '5mm diameter HG PVC duct.       600       m         'staat trenches for duct above, average depth 700mm, remove oft earth, lay ducts, backfill with soil and compact to natural round level.       1400       m         Allow for micro-tunnelling across tarmac roads       60       m         Cotal for Bill No. 14: Communication Distribution Ducting Z/F to Summary Page       Ducting       Ducting	Build 630 x 450 x 700mm deep standard Telkom Kenya       20       No.         SAFW steel cover.       20       No.         00mm diameter HG PVC duct.       220       m         xs above but with concrete surround       100       m         5mm diameter HG PVC duct.       600       m         nstall 6mm <sup>2</sup> SC-PVC-cable draw wire inside the above duct.       2200       m         Excavate trenches for duct above, average depth 700mm, remove oft earth, lay ducts, backfill with soil and compact to natural round level.       1400       m         Mlow for micro-tunnelling across tarmac roads       60       m       in         Total for Bill No. 14: Communication Distribution Ducting Z/F to Summary Page       m       in	Build 630 x 450 x 700mm deep standard Telkom Kenya       20       No.         Shuild 630 x 450 x 700mm deep standard Telkom Kenya       20       No.         Schwart Steel cover.       200       m         00mm diameter HG PVC duct.       2200       m         Sa above but with concrete surround       100       m         5mm diameter HG PVC duct.       600       m         nstall 6mm <sup>2</sup> SC-PVC-cable draw wire inside the above duct.       2200       m         sixcavate trenches for duct above, average depth 700mm, remove oft earth, lay ducts, backfill with soil and compact to natural round level.       1400       m         Mlow for micro-tunnelling across tarmac roads       60       m       1400       m         Storal for Bill No. 14: Communication Distribution Ducting Z/F to Summary Page       5000       m       5000       m

#### **BILL NO. 14: COMMUNICATION DISTRIBUTION DUCTING**

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.				(KSh. Cts.)	(Ksh Cts.)
	Supply, install, test, commission and set to work (to the full satisfaction of the Client, including initial training) the following:				
15.01	20 KVA true-on-line, uninterruptible power supply (UPS unit), with a 60 minute autonomy, both internal by-pass and external manual bypass, external 5000:1 voltage surge/spike protection, and all the other details as per technical specifications, including the options.	2	No.		
15.02	Allow for detailed training, demonstrations, full-load testing, providing technical manuals, users hand-book etc.		Item		
15.03	Liaison with Electrical sub-contractor to ensure proper cabling, phase-sequencing, and terminations are done.		Item		
15.04	Allow for preparation and presentation of detailed working drawings (and as-installed drawings on completion) both in hard and soft copies.		Item		
15.05	4C 25mm <sup>2</sup> PVC/SWA/PVC copper cables	100	m.		
15.05 (B	Cable glands for the above cable	2	No.		
15.05(C	Cable lugs for the above cable, complete with hydraulic crimping	8	No.		
15.05(d	4C 35mm <sup>2</sup> XLPE/SWA/XLPE copper cables	50	m.		
15.05(e	Cable glands for the above cable	2	No.		
15.06	Cable lugs for the above cable, complete with hydraulic crimping	8	No.		
	Total C/F to Page J/56				-

#### BILL NO. 15 – SUPPLY / INSTALLATION OF UPS EQUIPMENT

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMO	UNT
NO.					( Ksh	Cts.)
15.07	<ul> <li>Total B/F from Page J/55</li> <li>Allow for the following comprehensive performance testing of the UPS units to the entire satisfaction of the client and all parties to the contract:- <ol> <li>Full load testing of the 50KVA UPS unit with 100% 50KW</li> <li>00 p. f.) resistive load.</li> <li>Full load testing of 150 KVA UPS unit with 100% 150KW</li> <li>00 p. f.) resistive load.</li> <li>Full load testing of 150 KVA UPS unit with 100% 150KW</li> <li>00 p. f.) resistive load.</li> <li>Form <u>CONTINUOUS</u> 100% loading of each of the UPS units while on 50KW and 150 KW resistive load respectively.</li> </ol> </li> <li>iv. Provide cabling, connections, all accessories, instruments, tools and all the required items for above testing on the 'dry' resistive load</li> </ul>		Item			
	Total C/F to Summary Page					

### BILL NO. 15 – SUPPLY / INSTALLATION OF UPS EQUIPMENT

NO.	Supply, install, test, commission and set to work the following:	`		(Ksh Cts.)
	Supply, install, test, commission and set to work the following:			
16.00	Carry out comprehensive 24-hour power analysis, after installing main switchboard, but before switching on load, upgrading of switch-gear, with a digital power meter (with printer) to:			
	<ul> <li>i) Record and print all the power system parameters.</li> <li>ii) Submit 3 copies of the print-outs.</li> <li>(Note: Parameters must be satisfactory before building is switched on).</li> </ul>		Item	
16.01	<ul> <li>Carry out comprehensive testing and analysing of ALL EQUIPMENT, after installations. Prior to testing and commissioning conduct comprehensive programming of the systems by approved manufacturer's representative to perform as instructed by the Engineer The testing and commissioning will be done as detailed below.</li> <li>i) Prior to commencement of the work the contractor shall submit a procedure for the inspection, testing and commissioning of the systems. This procedure shall include for the visual and functional check/test of all components of the systems - the visual check will cover the standard of workmanship, the functional quality of the equipment and general compliance with the system specification and the functional tests shall check the operation of the system as a whole.</li> <li>ii) Commissioning will be undertaken by a qualified person using the approved inspection, testing and commissioning procedure.</li> <li>iii) On successful commissioning of the systems, in terms of the specified requirements, a Taking Over Certificate shall be completed. This is the written notification to the Service Provider/installer that the client has taken over the system in terms of the Agreement. Payment cannot be effected without this certificate vi) The Final Completion date for the system is determined from the Hand over Certificate. The taking over date is also that date on which the warranty period is deemed to have commenced.</li> <li>v) Each equipment in the installations shall be supplied with a complete installation manual and comprehensive operating instructions. In addition, cabling and wiring information, a list of all equipment with associated serial numbers, etc (as specified) and any other information that may be required by the client from time to time and a copy of the taking Over Certificate shall be provided in a A4 hard cover arch lever type file</li> </ul>			
	Total C/F to Page J/73			

#### **BILL NO. 16 – GENERAL ITEMS**

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/72				-
	vi) The contractor shall provide basic operating training on				
	the systems, using the operating instructions, for client staff prior				
	to the Taking over Certificate being issued. This training shall be				
	sufficient to ensure correct operation of the system. The				
	contractor shall issue certificates to certify that the operators are				
	proficient in the operation of the system on successful completion				
	of the system training. This training MUST be in the				
	manufacturer's representative's presence.				
	vii) The above documentation shall be handed to a selected				
	documentation to be as detailed below:				
	viji) System Documentation - all documentation relating to the				
	installation shall be concise, complete and unambiguous.				
	Information shall be provided sufficient to install, test and				
	commission, operate and maintain the system. Operating				
	instructions shall be designed to minimize the possibility of				
	incorrect operation of the system.				
	ix) Component documentation - documentation relating to the				
	components of the installation system shall also be concise,				
	complete and unambiguous. Sufficient information shall be				
	other of the sustems components. Component documentation				
	shall include the following:				
	shan menude the following				
	a) Name of manufacturer and / or supplier, including				
	MANUFACTURER's certification of the installation and				
	components, with a written 36-month performance warranty.				
	b) Description of equipment.				
	c) Standard to which component claims compliance and				
	Name or mark of the certification body.				
16.02	Acquire and submit a Bank Guarantee for 5% of the sub-contract		Itom		
	sum, as a Performance Guarantee.		nem		
16.03	Acquire and submit Insurance for the sub-contract work.		Item		
16.04	Allow for presentation of all the required samples as per		Itom		
	specifications, Bills of Quantities and Drawings.		nem		
	Total C/F to Page J/59				

### BILL NO. 16 – GENERAL ITEMS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/58				-
	-				
16.05	Prepare and submit Working Drawings as follows:-				
	<ul> <li>i) Draft soft copy in Archicad® and Autocad® 2000 in CD-RW.</li> <li>ii) Amended soft copy in Archicad® and Autocad® 2000 in CD-RW.</li> <li>iii) 5 Final soft copies in Archicad® and Autocad® 2000 in CD-RW to Architect, Client, Quantity Surveyor, and Engineer (2 copies)</li> <li>iv) 3 Draft hard-copies of Working Drawings in Ao (Scales 1:50, 1:25) to Engineer, Architect and Main Contractor.</li> <li>v) 2 Amended hard copies of Working Drawings in Ao (Scales 1:50 and 1:25) to Engineer, Architect and Main Contractor.</li> <li>vi) 11 No. Final hard copies of working drawings in Ao (Scales 1:50, 1:25) to Engineer (3 copies), Architect (1 copy), Quantity</li> </ul>	Item			
	Surveyor (1 copy), Client (3 copies), Contractor (3 copies).				
	(Note: Full set of drawings to be presented as per drawing list).				
18.06	As item no. 17.05, but for Record (As-Installed) Drawings comprising:			<u> </u>	
	i) Fully dimensioned drawings of all plants and apparatus.				
	ii) General arrangement drawings of equipment plant etc				
	iii) Routes – types and sizes and arrangement of all ninework				
	in routes types and sizes and an angement of an pipework.				
	<ul><li>iv) System schematics and trunking diagrams showing all salient information relating to control and instrumentation.</li><li>v) Grading charts</li></ul>		Item		
	<ul> <li>vi) Wiring and piping diagrams of plant and apparatus.</li> <li>vii) Schematic diagram of individual plants and switch and control boards.</li> <li>viii) All the required operating instructions for all panels, boards, control panels etc.</li> </ul>				
18.07	Prepare and submit Maintenance Manuals for all items installed.		Item		
18.08	Provide a year's (12 months') initial maintenance upon expiry of the Defects Liability Period. The maintenance to be carried out every quarter (3 months) for a period of 12 months.		Item		
	Total C/F to Page J/60	<u>-</u>	-		

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Page J/59				-
16.09	All other items of general preliminary to cover, but not limited to:-				
16.10	<ul> <li>i) Attendance on all other sub-contractors, such as for Communication Services, Mechanical Installations, Security Installations, Sound Equipment/ Wiring Installations, Generator Installations, Lift Services, Solar Water Heating, V-Sat services etc.</li> <li>ii) Hiring and keeping a Supervisor/Foreman on site</li> <li>iii) Constant supervision of the works.</li> <li>iv) Provision of all the required spares.</li> <li>v) Testing and Inspection of materials/works.</li> <li>vi) Provision of labour camps.</li> <li>vii) Storage of materials.</li> <li>viii) Initial maintenance (During Defects Liability)</li> <li>ix) Providing water/electricity for the works.</li> <li>x) Protection of the works/materials</li> <li>xi) Clearing away on completion.</li> <li>xii) Preparing Final Account.</li> <li>xiii) Providing all Test Certificates, etc.</li> <li>Allow for removal of any existing power services on site, comprising:-</li> <li>i) Applying to the Kenya Power to disconnect and remove such services, including any power meters that may be on site.</li> </ul>		Item		
	<ul> <li>ii) Making all the required liaison with KPLC to ensure speedy disconnection, removal, and/or re-routing of all services that may be existing on site.</li> <li>(Note: The tenderer <u>MUST</u> visit site to assess and establish the nature of all existing services on site).</li> </ul>		Item		
			Item		
	Total for Bill No. 17 – General Items, Carried Forward to Summary Page				-

#### BILL NO. 17 – GENERAL ITEMS

#### SUMMARY PAGE:

ITEM	DESCRIPTION	AMOUNT
NO.		(Ksh Cts.)
S.01	BILL NO. 1 – LECTURE ROOMS AND ADMINISTRATION BLOCK	-
S.02	BILL NO. 2 – LABORATORIES AND LECTURE ROOMS	-
S.03	BILL NO. 3 – WORKSHOP	-
S.04	BILL NO. 4 – KITCHEN AND DINNING BLOCK	-
S.05	BILL No. 5: HOSTELS	-
S.06	BILL No. 6: VILLAS	-
S.07	BILL NO. 7 – POWER ROOM	-
S.08	BILL NO. 8 – GUARD HOUSE	-
S.09	BILL NO. 9 – MAINS POWER DISTRIBUTION	-
S.10	Bill No. 10: Water Booster/Hose Reel Pump	-
S.11	Bill No. 11: Fire Detection and Alarm System	-
S.12	Bill No. 12: External Lighting	-
S.13	Bill No. 13: Lightning Protection	-
S.14	Bill No. 14: Communications Distribution Ducting	-
S.15	Bill No. 15: Supply/Installation of UPS Equipment	-
S.16	Bill No. 16: General Items B/F from Page	-
S.17	<ul> <li>Allow for sub-contractors charges for liaison with Kenya Power and Lighting comprising the</li> <li>i) Extracting load details from the drawings</li> <li>ii) Calculating total load, together with necessary diversity</li> <li>iii) Verifying the details with the engineer.</li> <li>iv) If need be getting the required documentation and letters from client for the purposes of</li> <li>v) Filling all the required forms, and generating correspondences for power application.</li> <li>vi) Presenting application and getting reference number.</li> <li>vii) Making regular follow-ups with Kenya Power</li> </ul>	
	<ul> <li>viii) Facilitating inspection, approvals and certification by Kenya Power</li> <li>ix) Providing attendance and materials required for power connection.</li> <li>x) Filling out and submitting Commencement and Completion certificates</li> </ul>	
S.20	Sub-Total C/F to Page J/62	-

#### SUMMARY PAGE (continued)

ITEM	TEM DESCRIPTION						
NO.		(Ksh Cts.)					
	Sub-Total B/F to Page J/61	-					
	<ul> <li>xi) Handing over all approved drawings and certificates to the client.</li> <li>xii) Performing all other services required for power supply to site.</li> <li>xiii) Building/modifying all power manholes to KPLC standards.</li> <li>xiv) All other incidental KPLC requirements/charges.</li> </ul>						
S.21	S.21 KPLC Application						
	Total Carried to Form of Tender						

Total Amount in words .....

.....

Tenderer's Name and Stamp .....

Signature	Date
PIN No	VAT No
Witness	Address

Signature ..... Date .....

ITEM NO.	DESCRIPTION	QTY	UNIT	RATE (KSh. Cts.)	AMOUNT (Ksh Cts.)
110.	Supply, install, test, commission and set to work (To the full	+		(110111 0101)	
	satisfaction of all parties to the contract) the following: -				
1.01a)	24-port Cisco switch as catalyst WS-C 2960-24PS-S superstack 10/100 mbps stackable PoE or approved equivalent	5	No.		
1.01b)	GBIC transceiver modules (LC to LC) multimode CISCO make for the switches above or approved equivalent	5	No.		
1.02a)	Dual Data cable outlets, type RJ45, complete with faceplates as Siemons or approved equivalent	75	No.		
1.02b)	CISCO wireless access points AS CISCO Airnet or approved equivalent	12	No.		
1.03a)	24 Port patch panel, type RJ45 Cat. 6A as Siemons or approved equivalent	5	No.		
1.03b)	Fiber optic patch panel, as Siemons or approved equivalent.	1	No.		
1.04a)	Purpose-made Free Standing cabinet (Type 42 U or equivalent) for the hub/patch-panel complete with extractor fan and 4 No. 3 pin power points on UPS. The cabinet to have front access glass door, all as per approved drawings	1	No.		
1.04b)	As above but 32 U	4			
1.05	FTP level 6A structured cables as Siemons or approved equivalent as Back-bone cabling for the switches, in redundant wiring.	240	m		
1.06a)	6 core multi-mode fibre for Back borne cabling for the switches above and other existing switches, in redundant wiring	240	m		
1.06b)	Multi-media converters DMC 530 SC	5	No.		
1.06c)	Fibre outlet dual MX-F-SC-01	5	No.		
1.06d)	LC-SC Multimode patch cords	5	No.		
1.06e)	LC-SC Multimode connectors	10	No.		
1.06f)	Splicing, termination, testing and commissioning of the above Fibre connections	1	Item		
1.07	UTP Cat 6A structured cables as Siemons or approved equivalent	40	Box		
1.08	UTP Cat. 6A patch cord, 3M as Siemons or approved equivalent	134	No.		
		l'			
	Total C/E to Page G2	_	_		_

### BILL No. 1 : LECTURE ROOMS AND ADMINSITRATION BLOCK

ITEM NO.	DESCRIPTION	QTY	UNIT	RATE	AMOUNT (Ksh Cts.)
110.	Total B/F from Page G/1				
1.09	UTP Cat. 6A patch cord, 1M as Siemons or approved equivalent	75	No.		
1.10	Data cable termination, both ends.	75	No.		
1.11	RJ45 Patch Cord as Siemens or approved equivalent	75	No.		
1.12	Cable organizers as approved	6	No.		
1.13	Allow for testing and commissioning of the installations.	1	Item		
1.14	Allow for fixing permanent labels on all the equipment and cables.	1	Item		
1.15	Power outlet for the 24-port switches, comprising 2 No. twin sockets, wiring in 2.5mm <sup>2</sup> ring-main wiring, conduit, box and all accessories.	6	No.		
	Total for Bill No. 1 Lecture rooms and Administration Block	-			

BILL No. 1 STRUCTURED LAN CABLING INSTALLATIONS FOR ADMINISTRATION BLOCK

ITEM NO	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.	Supply, install, test, commission and set to work (To the full satisfaction of all parties to the contract) the following: -				
2.01a)	24-port Cisco switch as catalyst WS-C 2960-24PS-S superstack 10/100 mbps stackable PoE or approved equivalent	2	No.		
2.01b)	GBIC transceiver modules (LC to LC) multimode CISCO make for the switches above or approved equivalent	2	No.		
2.02a)	Dual Data cable outlets, type RJ45, complete with faceplates as Siemons or approved equivalent	40	No.		
2.02b)	CISCO wireless access points or approved equivalent	4	No		
2.03a)	24 Port patch panel, type RJ45 Cat. 6A as Siemons or approved equivalent	2	No.		
2.03b)	Fiber optic patch panel, as Siemons or approved equivalent.	2	No.		
2.04	Purpose-made Free Standing cabinet (Type 42 U or equivalent) for the hub/patch-panel complete with extractor fan and 4 No. 3 pin power points on UPS. The cabinet to have front access glass door, all as per approved drawings	1	No.		
2.05	UTP Cat 6A structured cables as Siemons or approved equivalent	27	Box		
2.06	UTP Cat. 6A patch cord, 3M as Siemons or approved equivalent.	40	No.		
2.07	UTP Cat. 6A patch cord, 1M as Siemons or approved equivalent	40	No.		
2.08	Data cable termination, both ends.	40	No.		
2.09	RJ45 Patch Cord as Siemens or approved equivalent	40	No.		
2.10	Cable organizers as approved	4	No.		
2.11	Allow for testing and commissioning of the installations.	1	Item		
2.12	Allow for fixing permanent labels on all the equipment and cables.	1	Item		
2.13	Power outlet for the 24-port switches, comprising 2 No. twin sockets, wiring in 2.5mm <sup>2</sup> ring-main wiring, conduit, box and all accessories.	2	No.		
	Total for Bill No. 2 C/F to Summary Page				· .

### BILL No. 2 :LABORATORIES AND LECTURE ROOMS BLOCK

ITEM NO.	DESCRIPTION	QTY	UNIT	RATE	AMOUNT (Ksh Cts.)
110.	Supply, install, test, commission and set to work (To the full satisfaction of all parties to the contract) the following: -				
3.01(a	24-port Cisco switch as catalyst WS-C 2960-24 PS-S superstack 10/100 mbps stackable PoE or approved equivalent	1	No.		
3.01(b	GBIC transceiver modules (LC to LC) multimode CISCO make for the switches above or approved equivalent	1	No.		
3.02(a	Dual Data cable outlets, type RJ45, complete with faceplates as Siemons or approved equivalent	12	No.		
3.02(b	CISCO wireless access points or approved equivalent	3	No.		
3.03(a	12 Port patch panel, type RJ45 Cat. 6A as Siemons or approved equivalent	1	No.		
3.03(b	Fiber optic patch panel, as Siemons or approved equivalent.	1	No.		
3.04	Purpose-made Free Standing cabinet (Type 22 U or equivalent) for the hub/patch-panel complete with extractor fan and 4 No. 3 pin power points on UPS. The cabinet to have front access glass door, all as per approved drawings	1	No.		
3.05	UTP Cat 6A structured cables as Siemons or approved equivalent	7	Box		
3.06	UTP Cat. 6A patch cord, 3M as Siemons or approved equivalent.	Z 12	No.		
3.07	UTP Cat. 6A patch cord, 1M as Siemons or approved equivalent	12	No.		
3.08	Data cable termination, both ends.	12	No.		
3.09	RJ45 Patch Cord as Siemens or approved equivalent	12	No.		
3.10	Cable organizers as approved	1	No.		
3.11	Allow for testing and commissioning of the installations.	1	Item		
3.12	Allow for fixing permanent labels on all the equipment and cables.	1	Item		
3.13	Power outlet for the 12-port switches, comprising 2 No. twin sockets, wiring in 2.5mm <sup>2</sup> ring-main wiring, conduit, box and all accessories.	2	No.		
3.14	Allow for structured cable termination at all computer terminals, attendance in power connection, testing and commissioning of the network to TSD-ISN Standards.	1	Item		
	Total for Bill No. 3 C/F to Summary Page				

#### BILL No. 3 STRUCTURED LAN CABLING INSTALLATIONS FOR WORKSHOP

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Supply, install, test, commission and set to work (To the full satisfaction of all parties to the contract) the following: -				
4.01(a	12-port Cisco switch as catalyst WS-C 2960-12 PS-S superstack 10/100 mbps stackable PoE or approved equivalent	1	No.		
4.01(b	GBIC transceiver modules (LC to LC) multimode CISCO make for the switches above or approved equivalent	1	No.		
4.02	Dual Data cable outlets, type RJ45, complete with faceplates as Siemons or approved equivalent.	12	No.		
4.03	24 Port patch panel, type RJ45 Cat. 6A as Siemons or approved equivalent	2	No.		
4.03(b	Fiber optic patch panel, as Siemons or approved equivalent.	2	No.		
4.04	Purpose-made Free Standing cabinet (Type 22 U or equivalent) for the hub/patch-panel complete with extractor fan and 4 No. 3 pin power points on UPS. The cabinet to have front access glass door, all as per approved drawings	1	No.		
4.05	UTP Cat 6A structured cables as Siemons or approved equivalent	3	Boxes		
4.06	UTP Cat. 6A patch cord, 3M as Siemons or approved equivalent.	12	No.		
4.07	UTP Cat. 6A patch cord, 1M as Siemons or approved equivalent	12	No.		
4.08	Data cable termination, both ends.	24	No.		
4.09	RJ45 Patch Cord as Siemens or approved equivalent	12	No.		
4.10]	Cable organizers as approved	1	No.		
4.11	Allow for testing and commissioning of the installations.	1	Item		
4.12	Allow for fixing permanent labels on all the equipment and cables.	1	Item		
4.13	Power outlet for the 12-port switches, comprising 2 No. twin sockets, wiring in 2.5mm <sup>2</sup> ring-main wiring, conduit, box and all accessories.	1	No.		
4.14	Allow for structured cable termination at all computer terminals, attendance in power connection, testing and commissioning of the network to TSD-ISN Standards.	1	Item		
	1 otal For 1 No Hostel Block				-
	Total for 2 No. Hostels Bill No. 4 C/F to Summary Page				

# BILL No. 4 STRUCTURED LAN CABLING INSTALLATIONS FOR HOSTELS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.	Supply install test commission and set to work (To the full				(Ksh Cts.)
	satisfaction of all parties to the contract) the following: -				
5.01(a	12-port Cisco switch as catalyst WS-C 3750-24PS-S superstack 10/100 mbps stackable PoE or approved equivalent	-port Cisco switch as catalyst WS-C 3750-24PS-S superstack /100 mbps stackable PoE or approved equivalent 1 No.			
5.01(b	GBIC transceiver modules (LC to LC) multimode CISCO make for the switches above or approved equivalent	1	No.		
5.02(a	Dual Data cable outlets, type RJ45, complete with faceplates as Siemons or approved equivalent.	8	No.		
5.02(b	CISCO wireless access points or approved equivalent	1	No		
5.03(a	12 Port patch panel, type RJ45 Cat. 6A as Siemons or approved equivalent	1	No.		
5.03(b	Fiber optic patch panel, as Siemons or approved equivalent.	1	No.		
5.04	Purpose-made Free Standing cabinet (Type 22 U or equivalent) for the hub/patch-panel complete with extractor fan and 4 No. 3 pin power points on UPS. The cabinet to have front access glass door, all as per approved drawings	1	No.		
5.05	FTP level 6A structured cables as Siemons or approved equivalent as Back-bone cabling for the switches, in redundant wiring.		Box		
5.06(b	Multi-media converters DMC 530 SC	1	No.		
5.06(b	Fibre outlet dual MX-F-SC-01	1	No.		
5.06(c	LC-SC Multimode patch cords	1	No.		
5.06(d	LC-SC Multimode connectors	1	No.		
5.06(f	Splicing, termination, testing and commissioning of the above Fibre connections	1	Item		
5.07	UTP Cat 6A structured cables as Siemons or approved equivalent	2	Box		
5.08	UTP Cat. 6A patch cord, 3M as Siemons or approved equivalent.	8	No.		
5.09]	UTP Cat. 6A patch cord, 1M as Siemons or approved equivalent	8	No.		
5.10	Data cable termination, both ends.	16	No.		
5.11	RJ45 Patch Cord as Siemens or approved equivalent	8	No.		
5.12	Cable organizers as approved	1	No.		
5.13	Allow for testing and commissioning of the installations.	1	Item		
5.14	Allow for fixing permanent labels on all the equipment and cables.	1	Item		
	Total for Bill No. 5 Villas C/F to Summary Page				-

# BILL No. 5 STRUCTURED LAN CABLING INSTALLATIONS FOR VILLAS

DILLI	10. 0 STRUCTURED LAW CADEING INSTALLATIONS FOR				
ITEM NO.	DESCRIPTION	QTY	UNIT	RATE	AMOUNT (Ksh Cts.)
	Supply, install, test, commission and set to work (To the full satisfaction of all parties to the contract) the following: -				
6.01a)	24-port Cisco switch as catalyst WS-C 2960-24PS-S superstack 10/100 mbps stackable PoE or approved equivalent	1	No.		
6.01b)	GBIC transceiver modules (LC to LC) multimode CISCO make for the switches above or approved equivalent	1	No.		
6.02a)	Dual Data cable outlets, type RJ45, complete with faceplates as Siemons or approved equivalent.	10	No.		
6.02b)	CISCO wireless access points or approved equivalent	3	No		
6.03a)	24 Port patch panel, type RJ45 Cat. 6A as Siemons or approved equivalent	1	No.		
6.03b)	Fiber optic patch panel, as Siemons or approved equivalent.	1	No.		
6.04a)	Purpose-made Free Standing cabinet (Type 32 U or equivalent) for the hub/patch-panel complete with extractor fan and 4 No. 3 pin power points on UPS. The cabinet to have front access glass door, all as per approved drawings	1	No.		
6.05	FTP level 6A structured cables as Siemons or approved equivalent as Back-bone cabling for the switches, in redundant wiring.	1	Box		
6.06a)	6 core multi-mode fibre for Back borne cabling for the switches above and other existing switches, in redundant wiring	120	m		
6.06b)	Multi-media converters DMC 530 SC	1	No.		
6.06c)	Fibre outlet dual MX-F-SC-01	1	No.		
6.06d)	LC-SC Multimode patch cords	1	No.		
6.07	UTP Cat 6A structured cables as Siemons or approved equivalent	5	Box		
6.08	UTP Cat. 6A patch cord, 3M as Siemons or approved equivalent.	10	No.		
6.09	UTP Cat. 6A patch cord, 1M as Siemons or approved equivalent	10	No.		
6.10	Data cable termination, both ends.	20	No.		
6.11	RJ45 Patch Cord as Siemens or approved equivalent	10	No.		
6.12	Cable organizers as approved	10	No.		
6.13	Allow for testing and commissioning of the installations.	1	Item		
6.14	Allow for fixing permanent labels on all the equipment and cables.	1	Item		
	Total for Bill No. 6 C/F to Summary Page				-

BILL No.	<b>6 STRUCTURED</b>	LAN CABLING	INSTALLATIONS FOR	R KITCHEN AND DIN	NING BLOCK

ITEM NO.	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
110.	Supply, install, test, commission and set to work (To the full satisfaction of all parties to the contract) the following: -				
7.01	Core switch as CISCO CATALYST 6500 series or approved aquivalent with modular ports, 100 BASE-FX switched, 10/100 auto sensing switched, 10/100/1000 Base T, 10 Gigabit Ethernet, Intergrated PoE, Intergrated service modules for Fire Wall Services, Intrusion Detection, Network Analysis (NAM), Wireless (WiSM), Application Control Engine (ACE), Voice Gateway (CMM), Anomaly Detection and Guard, IP sec VPN (SCC-400). The switch to also have WAN modules, SIP/SPA, Enhanced FlexWAN	1	No.		
7.02a)	24-port Cisco switch as catalyst WS-C 2960-24PS-S superstack 10/100 mbps stackable PoE or approved equivalent	1	No.		
7.02b)	GBIC transceiver modules (LC to LC) multimode CISCO make for the switches above or approved equivalent	1	No.		
7.03a)	24 Port patch panel, type RJ45 Cat. 6A as Siemons or approved equivalent	2	No.		
7.03b)	Fiber optic patch panel, as Siemons or approved equivalent.	2	No.		
7.04	Purpose-made Free Standing cabinet (Type 42 U or equivalent) for the hub/patch-panel complete with extractor fan and 4 No. 3 pin power points on UPS. The cabinet to have front access glass door, all as per approved drawings	1	No.		
7.05	STP level 6A structured cables as Siemons or approved equivalent as Back-bone cabling for the switches, in redundant wiring.	500	m		
7.06a)	16 core multi-mode fibre for Back borne cabling for the switches in all other buildings, in redundant wiring	1,000	m		
7.06b)	Multi-media converters DMC 530 SC	1	No.		
7.06c)	Fibre outlet dual MX-F-SC-01	1	No.		
7.06d)	LC-SC Multimode patch cords	1	No.		
7.06e)	LC-SC Multimode connectors	2	No.		
7.06f)	Splicing, termination, testing and commissioning of the above Fibre connections	1	Item		
7.07	UTP Cat. 6 A patch cord, 1M as Siemons or approved equivalent	30	No.		
7.08	Cable organizers as approved	1	No.		
	Total C/F to Page G/9				-

#### **BILL No. 7: INTERCONNECTION OF BUILDINGS**

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMO	UNT
NO.					( Ksh	Cts.)
	Total B/F to Page G/8					-
7.10	Allow for testing and commissioning of the installations.	1	Item			
7.11	Allow for fixing permanent labels on all the equipment and cables.	1	Item			
7.12	200-pair cross connector.	6	No.			
7.13	200 Pair discase as KRONE complete with surge arrestor	6	No.			
7.14	Power outlet for the 24-port switches, comprising 2 No. twin sockets, wiring in 2.5mm <sup>2</sup> ring-main wiring, conduit, box and all accessories.	1	No.			
7.15	Allow for structured cable termination at all computer terminals, attendance in power connection, testing and commissioning of the network to TSD-ISN Standards.	1	Item			
7.16	Allow for integration of the New PABX and all other network handsets into the new cabling network for receiving, handling, testing and full configuration.	1	Item			
	NB: All to CISCO Solutions or approved equivalent					
7.17	Any other items necessary to complete the data cabling satisfactorily. Please list the items. (i)(ii)					
	Total for Bill No.7 C/F to Summary Page					

#### **BILL No. 7: INTERCONNECTION OF BUILDINGS**

ITEM NO	DESCRIPTION	QTY	UNIT	RATE	AMOUNT KSH CTS
NO.	Supply, install, test, commission and set to work (to the full satisfaction of all the Parties) the following:				кэп. стэ.
8.00	Fully programmable, 25 No. User Capacity Hybrid Electronic PABX complete with an integral control unit/MDF assembly and all accessories as <b>described in the Technical Specifications</b> ( <b>Part F</b> ). The set to be fully configured.	2	No.		
8.01a)	Connection of client supplied Programmable telephone set with line cord.	50	No.		
8.01b)	Connection of client supExecutive telephone sets with LCD screen auto-redial, date/time indicator flasher/hold, sp-phone, mute, auto- answer, pause, transfer etc.	18	No.		
8.02					
	State the following:-				
	Make of PABX equipment on offer				
	Country of origin				
	Number of institutions already using this type of equipment in Kenya				
	(A technical brochure and product catalogues must be enclosed)				
8.03	Power back-up unit for the PABX with a minimum 12-hour back- up time when all the extensions and lines are in use (State make and type).	1	No.		
8.04	Sollatek hi-volt guard.	8	No.		
8.05	Line protectors, as Furse or equivalent.	50	Pcs		
8.06	Amphinol connectors	50	Pcs		
8.08	Allow for the Connection of the new PABX to the MDF	1	Item		
8.09a)	Client preffered ISP Charges for 5 No new wireless lines as HUAWEI or approved equivalent, including getting all the required documents from the client, Collecting and filling all the forms presenting the application at Telkom Kenya, making follow- ups, providing all the attendance required, terminating the new lines onto the PABX, testing and programming to clients requirements	10	lines		
8.09b)	Charges for 5 No new GSM lines as approved by client, including getting all the required documents from the client, Collecting and filling all the forms presenting the application, making follow-ups, providing all the attendance required, terminating the new lines onto the PABX, testing and programming to clients requirements	10	lines		
	Total C/F to Page C/11	1			

BILL NO. 8 – SUPPLY / INSTALLATION OF PABX AND TELEPHONE EQUIPMENT

ITEM NO.	DESCRIPTION	QTY	UNIT	RATE	AMOUNT KSH. CTS.
	Total B/F from Page G/10				-
8.1	<ul> <li>The following costs to be included:-</li> <li>i) Filling out the necessary official forms to apply for all the lines.</li> <li>ii) Submitting the application forms</li> <li>iii) Obtaining quotation</li> <li>iv) Making payment for the lines (tenderer to pay)</li> <li>v) Liasing with provider for connecting, switching on/and testing all the lines</li> <li>vi) Terminating all the lines to user terminal equipment</li> <li>vii) Demonstration and training to the users</li> </ul>		Item		-
8.12	Allow for testing and comprehensive programming (for customization of the telephone system to each of the extensions). Other tailor made programming to user's needs, including conducting a general demonstration to all users and handing over of a completely operational installation and all manuals as spelt out in the Technical Specifications		Item		
8.13	Allow for liaison with Communication authority (CA) for certification of the installed equipment.		Item		
8.14	Warranty: The warranty period for the workmanship, all materials and the equipment installed will be months after commissioning.				
	(Note: A minimum of 12 calendar months will be accepted. During warranty, all defective workmanship/materials will be replaced free of cost.				
	Total C/F to Summary Page				-

BILL NO. 8 – SUPPLY / INSTALLATION OF PABX AND TELEPHONE EQUIPMENT

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					KSH. CTS.
	Supply, install, test, commission and set to work (To the full				
	satisfaction of all parties to the contract) the following: -				
0.00					
9.00	Carry out comprehensive Communications intrastructure and				
	PABA Equipment instantions lesting and analysis, after				
	installations. Prior to testing and commissioning conduct				
	comprehensive programming of the system by approved				
	Engineers including single actions The testing and				
	Engineer, including ringing patterns The testing and				
	commissioning will be done as detailed below.				
	i) Prior to commencement of the work the contractor shall				
	submit a procedure for the inspection, testing and commissioning				
	of the system. This procedure shall include for the visual and				
	functional check/test of all components of the system - the visual				
	check will cover the standard of workmanship, the functional				
	quality of the equipment and general compliance with the system				
	specification and the functional tests shall check the operation of				
	the system as a whole.				
1					
	ii) Commissioning will be undertaken by a qualified person			$\geq$	
	using the approved inspection, testing and commissioning				
	procedure.				
	iii) On successful commissioning of the system, in terms of				
	the specified requirements, a Taking Over Certificate shall be				
	completed. This is the written notification to the Service				
	Provider/installer that the client has taken over the system in terms				
	of the Agreement. Payment cannot be effected without this				
	certificate				
	from the Hand over Certificate. The taking over data is also that				
	deta on which the warments period is deemed to have common and				
	date off which the warranty period is deemed to have commenced.				
	v) Each equipment in the installations shall be supplied				
	with a complete installation manual and comprehensive operating				
	instructions. In addition, cabling and wiring information, a list of				
	all equipment with associated serial numbers, etc (as specified)				
	and any other information that may be required by the client from				
	time to time and a copy of the taking Over Certificate shall be				
	provided in a A4 hard cover arch lever type file				
<b> </b>					
1	v1) The contractor shall provide basic operating training				
	on the system, using the operating instructions, for client staff prior				
	to the Taking over Certificate being issued. This training shall be				
	sufficient to ensure correct operation of the system. The contractor				
	shall issue certificates to certify that the operators are proficient in				
	the operation of the system on successful completion of the system				
	training. This training $M \cup ST$ be in the manufacturer's				
	representative's presence.				
1					
I					

#### BILL NO. 9 – GENERAL ITEMS

BILL NO. 9 – GENERAL ITEMS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					KSH. CTS.
	<ul> <li>vii) The above documentation shall be handed to a selected client representative at the time of commissioning. The documentation to be as detailed below:-</li> <li>viii) System Documentation - all documentation relating to the installation shall be concise, complete and unambiguous. Information shall be provided sufficient to install, test and commission, operate and maintain the system. Operating instructions shall be designed to minimize the possibility of incorrect operation of the system.</li> <li>ix) Component documentation - documentation relating to the components of the installation system shall also be concise, complete and unambiguous. Sufficient information shall be provided to ensure the integration of the component with any other of the system's components. Component documentation shall include the following:-</li> <li>c) Standard to which component claims compliance.</li> </ul>				
0.01	d) Name or mark of the certification body.				
9.01	sum, as a Performance Guarantee.		Item		
9.02	Acquire and submit Insurance for the sub-contract work.		Item		
9.03	Allow for presentation of all the required samples as per specifications, Bills of Quantities and Drawings.		Item		
9.04	Prepare and submit Working Drawings as follows:-				
9.05	<ul> <li>i) Draft soft copy in Archicad® and Autocad® 2000 in CD-RW.</li> <li>ii) Amended soft copy in Archicad® and Autocad® 2000 in CD-RW.</li> <li>iii) 5 Final soft copies in Archicad® and Autocad® 2000 in CD-RW to Architect, Client, Quantity Surveyor, and Engineer (2 copies)</li> <li>iv) 3 Draft hard-copies of Working Drawings in Ao (Scales 1:50, 1:25) to Engineer, Architect and Main Contractor.</li> <li>As item no. 9.04, but for Record (As-Installed) Drawings comprising:</li> <li>Fully dimensioned drawings of all plants and apparatus.</li> <li>General arrangement drawings of equipment, plant etc.</li> <li>Routes – types and sizes and arrangement of all pipework.</li> <li>System schematics and trunking diagrams showing all salient information relating to control and instrumentation.</li> <li>Grading charts</li> <li>Wiring and piping diagrams of plant and apparatus.</li> <li>Schematic diagram of individual plants and switch and control boards.</li> <li>All the required operating instructions for all panels, boards, control panels etc.</li> </ul>		Item		
	Total C/F to Page G/14				

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					KSH. CTS.
9.06 9.07	<b>Total B/F to Page G/15</b> Provide a year's (12 months') initial maintenance upon expiry of the Defects Liability Period. The maintenance to be carried out every quarter (3 months) for a period of 12 months. All other items of general preliminary to cover, but not limited to:-		Item		-
	<ul> <li>Attendance on all other sub-contractors, such as for UPS Installations, Structured LAN Cabling, Fire Detection and Alarm System, Electrical Installations, Audio Visual Installations, Generator Installations, Lift Services, Solar Water Heating, V-Sat services etc.</li> <li>Hiring and keeping a Supervisor/Foreman on site</li> <li>Constant supervision of the works.</li> <li>Provision of all the required spares.</li> <li>Testing and Inspection of materials/works.</li> <li>Provision of labour camps.</li> <li>Storage of materials.</li> <li>Initial maintenance (During Defects Liability)</li> <li>Protection of the works/materials</li> <li>Clearing away on completion.</li> <li>Preparing Final Account.</li> <li>Providing all Test Certificates, etc.</li> </ul>	Item			
	Total for General Items Carried Forward to Summary Page				

#### **BILL NO. 9 – GENERAL ITEMS**

#### SUMMARY PAGE

ITEM	DESCRIPTION	AMOUNT
NO.		(Ksh Cts.)
1.00	BILL No. 1 : LECTURE ROOMS AND ADMINSITRATION BLOCK	-
2.00	BILL No. 2 :LABORATORIES AND LECTURE ROOMS BLOCK	-
3.00	BILL No. 3 STRUCTURED LAN CABLING INSTALLATIONS FOR WORKSHOP	-
4.00	BILL No. 4 STRUCTURED LAN CABLING INSTALLATIONS FOR HOSTELS	-
5.00	BILL No. 5 STRUCTURED LAN CABLING INSTALLATIONS FOR VILLAS	-
6.00	BILL No. 6 STRUCTURED LAN CABLING INSTALLATIONS FOR KITCHEN AND DINING BLOCK	-
7.00	BILL No. 7: INTERCONNECTION OF BUILDINGS	-
8.00	BILL NO. 8 – SUPPLY / INSTALLATION OF PABX AND TELEPHONE EQUIPMENT	-
9.00	BILL NO. 9 – GENERAL ITEMS	
10.00		
10.00	50D-10(a)	-
	Total Amount Carried to Form of Tender	

Total Amount in words					
Tenderer's Name and Stamp					
Signature	Date				
PIN No	VAT No				
Witness	Address				
Signature	Date				
ITFM	DESCRIPTION	OTV	UNIT	RATE	AMOUNT
------	--	---------	------	------	------------
NO.	DESCRIPTION	~	UI	MIL	(Ksh Cts.)
1.01	Supply 800 kg (10 persons) machine-room-less passenger lifts with durable flat polyurethane coated high-tensile grade steel belts, suitable for Two stops and opening and complete with all auxiliaries, gearless drive, control panel etc., and partial glazing and all other details as described in the technical specifications (PART A). The price to include taxes and duties.	1	No.		
1.02	Installation and commissioning of the 1 No. Passenger Lift. The testing and commissioning will be done as detailed below:				
	<ul> <li>i) Prior to commencement of the commissioning work, the contractor shall submit a procedure for the inspection, testing and commissioning of the lifts. This procedure shall include all the visual and functional check/test of all components of the lift system - the visual check will cover the standard of workmanship, the functional quality of the equipment and general compliance with the lift specification and the functional tests shall check the operation of the lift system as a whole.</li> <li>ii) Commissioning will be undertaken by a qualified person using the approved inspection, testing and commissioning procedure.</li> <li>iii) On successful commissioning of the system, in terms of the specified requirements, a Taking Over Certificate shall be completed. This is the written notification to the lifts installer that the appointed client representatives have taken over the installation in terms of the Agreement. Payment cannot be effected without this certificate</li> <li>iv) The Final Completion date for the lift system installation is determined from the Hand over Certificate. The taking over date is also that date on which the warranty period is deemed to have commenced.</li> </ul>		Item		
1.03	Maintenance for 12 months of 2 No. Passenger Lift as described in the Technical Specifications		Item		
1.04	Any other item which the Tenderer wishes to add (please state)		Item		
1.05	415V Surge diverter as Furze ESP 415, or approved equivalent, complete with purpose-made enclosure with viewing window	2	No.		
	Total C/F to Summary Page for Passenger /Goods Lifts Inst	allatio	ns		-

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
2.00	Carry out comprehensive 24-hour power analysis and all Lifts Tests, after installing the lift, with a digital power meter (with printer) to:				
	<ul><li>i) Record and print all the power system parameters.</li><li>ii) Submit 3 copies of the print-outs.</li></ul>		Item		
	(Note: Parameters must be satisfactory before power is switched on).				
2.01	Allow for presentation of all the required samples as per specifications, Bills of Quantities and Drawings.		Item		
2.02	Prepare and submit Working Drawings as follows:-				
	<ul> <li>i) Draft soft copy in Archicad® and Autocad® 2000 in CD-RW.</li> <li>ii) Amended soft copy in Archicad® and Autocad® 2000 in CD-RW.</li> <li>iii) 4 Final soft copies in Archicad® and Autocad® 2000 in CD-RW to Architect, Client, Quantity Surveyor, and Engineer (2 copies)</li> <li>iv) 4 Draft hard-copies of Working Drawings in Ao (Scales 1:50, 1:25) to Engineer, Architect and Main Contractor.</li> <li>v) 4 Amended hard copies of Working Drawings in Ao (Scales 1:50 and 1:25) to Engineer, Architect and Main Contractor.</li> <li>vi) 4 No. Final hard copies of working drawings in Ao (Scales 1:50, 1:25) to Engineer (3 copies), Architect (1 copy), Quantity Surveyor (1 copy), Client (3 copies), Contractor (3 copies).</li> <li>(Note: Full set of drawings to be presented as per drawing list).</li> </ul>		Item		
2.03	<ul> <li>As item no. 2.02, but for Record (As-Installed) Drawings comprising:</li> <li>i) Fully dimensioned drawings of all plants and apparatus.</li> </ul>				
	<ul> <li>ii) General arrangement drawings of equipment, plant</li> <li>etc.</li> <li>iii) Routes – types and sizes and arrangement of all</li> <li>pipework.</li> <li>iii) System schematics and (a big big big big big big big big big big</li></ul>				
	iv) System schematics and trunking diagrams showing all salient information relating to control and instrumentation.				
	Total C/F to Next Page	_		-	

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
2.04	<ul> <li>V) Grading charts</li> <li>Vi) Grading charts</li> <li>Vi) Wiring and piping diagrams of plant and apparatus.</li> <li>Vii) Schematic diagram of individual plants and switch and control boards.</li> <li>Viii) All the required operating instructions for all panels, boards, control panels etc.</li> <li>Prepare and submit Maintenance Manuals for all items installed.</li> </ul>		Item		-
2.05	Provide a year's (12 months') initial maintenance upon expiry of the Defects Liability Period. The maintenance to be carried out every quarter (3 months) for a period of 12 months.		Item		
2.06	<ul> <li><u>All other items</u> of general preliminary to cover, but not limited to: -</li> <li>Attendance on all other sub-contractors, such as for Electrical Installations, Structured LAN Cabling, PABX Installations, Fire Detection and Alarm Installations, UPS Equipment Installations, Generator Installations, Audio Visual Equipment Installations, Solar Water Heating, V-Sat services etc.</li> <li>Hiring and keeping a Supervisor/Foreman on site</li> <li>Constant supervision of the works.</li> <li>Provision of all the required spares.</li> <li>Testing and Inspection of materials/works.</li> <li>Provision of labour camps.</li> <li>Storage of materials.</li> <li>Initial maintenance (During Defects Liability)</li> <li>Providing water/electricity for the works.</li> <li>Protection of the works/materials</li> <li>Clearing away on completion.</li> <li>Preparing Final Account.</li> <li>Providing all Test Certificates, etc.</li> </ul>		Item		
	Total C/F to next page				-

ITEM NO.	DESCRIPTION	QTY	UNIT	RATE	AMOUNT (Ksh Cts.)
2.07	<b>Total B/F from Page L4/6</b> Provide basic operating/trouble shooting training on the lift system, using the operating instructions, for client's selected staff prior to the Taking over Certificate being issued This training shall be sufficient to ensure correct operation and solution of minor problems of the lift system. The contractor shall issue certificates to certify that the operators are proficient in the operation of the system and basic trouble shooting on the installation on successful completion of the lift system training.		Item		
	Total for Bill No. 2 C/F to Summary Page for Passenger Lif	fts Insta	allation	S	-

#### SUMMARY PAGE

ITEM NO.	DESCRIPTION	AMOUNT (Ksh Cts.)
1.00	Bill No. 1: Supply / Installation of Passenger Lifts	-
2.00	Bill No. 2: General Items,	-
	Total Amount Carried to Summary Page for Electrical Installations and Associated Services	-

1.00	ITEM DETAILS		AMOUNT		
NO.		( Ksh	Cts.)		
1.01	Supply of <b>1 No.</b> 500 KVA* sound-Attenuated Prime Rated generating set as Prkins or approved equivalent . Generator to be 415V/240V 3-phase, 1500 rpm, Max 60 dBA at 1 M. (*Site rating, to be achieved in Naivasha which is at 1700 m asl. Supplier to state actual sea-level rating as per appendices 1 and 2).		,		
1.02	Installation of the Generating set				
1.03	Supply of daily service tank				
1.04	Installation of daily service tank				
1.05	Supply of control panel(s), (complete with ov/uv relays)				
1.06	Installation of control panel(s)				
1.07	Supply of Automatic changeover contactor unit(s) (in Main switchboard)				
1.08	Installation for Automatic changeover contactor unit(s) (in main switchboard)				
1.09	1000A TPN Manual by-pass system across the AMF panel to be complete with 4 No 1000A TPN Manual change over switch for bypassing both the mains and the generator, a firmly bonded enclosure in 12 gauge galvanized steel, and finished in stove enameled appropriately coloured paint, mounting rails, and sufficient space for cable termination and mounting of switches				
1.10	Comprehensive and detailed testing/Commissioning of set as per full procedures set out in the Technical Specifications				
1.11	Supply of manual fuel transfer pump plus the necessary piping to interconnect the daily service tank and the fuel storage tank				
1.12	Installation of the manual fuel transfer pump and all pipework				
1.13	Industrial silencer for the generator				
1.17	Flue/Exhaust fumes damping chamber/pit complete with Compartments and water for carbon and soot absorption before discharge through Mild Steel pipe of sufficient diameter to avoid back pressure. The damping pit should also act as sound attenuator for the engine. This chamber to be complete with all the ancillary installations to perform satisfactorily				
1.18	Hot air ducting as per Engineers details				
1.19	2000 lts (2m <sup>3</sup> ) external Steel fuel tank, as per Engineers details With 1.5 inch Dia. Galvaized Iron Piping to the Generator with Qarter turn Control valves				
	Total C/F to Next Page		-		

ITEM	ITEM DETAILS	AMOUNT
NO.		(Ksh Cts.)
	Total B/F from Previous Page	-
1.20	450mmx100mm metal cable tray complete with supports, cable ties and all accessories, manufactured in 14 gauge galvanised steel, 60m	
1.23	The following <b>mandatory</b> tests to be performed on the prime rated generator set to the i. Off-load tests ii. Full-load tests with resistive loads, up to 110% loading iii. Demonstration of the performance and function of the Change over Unit including iv. Provision of all the required instrument, tools and fuel required to undertake a 24- hour full-load performance testing of the set while on load	
1.24	Introduce external anti-vibration dumpers to supplement the factory-made ones	
1.25	Any other items (to be detailed)	
1.26	4C 150mm <sup>2</sup> PVC/SWA/PVC copper cable 50 m	
1.27a)	Cable glands for the above cable, 4 No.	
1.27b)	Cable lugs for the above cable, Complete with hydraulic crimping, 16 No.	
1.28	3C 4mm <sup>2</sup> PVC/SWA/PVC copper control cable, 40 m	
1.29a)	Cable glands for the above cable, 2 No.	
1.29b)	Cable lugs for the above cable, 8 No.	
	Total C/F to Summary Page for Generator Installations	

### BILL NO. 1: PRIME RATED GENERATOR SET AND ASSOCIATED WORKS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.		-			(Ksh Cts.)
2.00	Carry out comprehensive 24-hour power analysis, after installation of the Generator set and switch gear, with a digital power meter (with printer) to:				
	i) Record and print all the power system parameters.				
	ii) Submit 5 copies of the printouts.				
	(Note: Parameters must be satisfactory before the generator set is switched on).		Item		
2.01	Acquire and submit a Bank Guarantee for 10% of the sub-contract sum, as a Performance Guarantee.		Item		
2.02	Acquire and submit Insurance for the sub-contract work.		Item		
2.03	Allow for presentation of all the required samples as per specifications, Bills of Quantities and Drawings.		Item		
2.04	Prepare and submit Working Drawings as follows:-				
	<ul> <li>i) Draft soft copy in Archicad® and Autocad®</li> <li>2000 in CD-RW.</li> <li>ii) Amended soft copy in Archicad® and Autocad®</li> <li>2000 in CD-RW.</li> <li>iii) 5 Final soft copies in Archicad® and Autocad®</li> <li>2000 in CD-RW to Architect, Client, Quantity</li> <li>2000 in CD-RW to Architect, Client, Quantity</li> <li>Surveyor, and Engineer (2 copies)</li> <li>iv) 3 Draft hard-copies of Working Drawings in Ao</li> <li>(Scales 1:50, 1:25) to Engineer, Architect and Main</li> <li>Contractor.</li> <li>v) 2 Amended hard copies of Working Drawings in</li> <li>Ao (Scales 1:50 and 1:25) to Engineer, Architect and</li> <li>Main Contractor.</li> <li>vi) 11 No. Final hard copies of working drawings in</li> <li>Ao (Scales 1:50, 1:25) to Engineer (3 copies),</li> </ul>		Item		
	Architect (1 copy), Quantity Surveyor (1 copy), Client (3 copies), Contractor (3 copies).				
	(Note: Full set of drawings to be presented as per drawing list).				
2.05	As item no. 2.04, but for Record (As-Installed) Drawings comprising:				
	i) Fully dimensioned drawings of all plants and apparatus.				

# INSTALLATION

To<u>tal C/F to next Page</u>

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					(Ksh Cts.)
	Total B/F from Previous Page			(	-
	ii) General arrangement drawings of equipment, plant				
	etc.				
	iii) Routes – types and sizes and arrangement of all				
	pipework.				
	iv) System schematics and trunking diagrams				
	showing all salient information relating to control and				
	instrumentation.				
	v) Grading charts				
	vi) Wiring and piping diagrams of plant and				
	apparatus.				
	vii) Schematic diagram of individual plants and				
	switch and control boards.				
2.06	Prepare and submit Maintenance Manuals for all items		Item		
	installed.				
2.07	Provide a year's (12 months') initial maintenance		Item		
	upon expiry of the Defects Liability Period. The				
	maintenance to be carried out every quarter (3				
	months) for a period of 12 months.				
2.08	<u>All other items</u> of general preliminary to cover, but				
	not limited to:-				
	N Attenden in the state of the				
	1) Attendance on all other sub-contractors, such as $C$				
	for Communication Services, Mechanical				
	Installations, Security Installations, Sound Equipment/				
	Wiring Installations, Generator Installations, Lift				
	Services, Solar Water Heating, V-Sat services etc.				
	ii) Uiring and keeping a Supervisor/Foreman on site				
	ii) Hining and keeping a Supervisor/Foreman on site				
	iii) Constant supervision of the works				
	iv) Provision of all the required spares				
	y) Testing and Inspection of materials/works				
	vi) Provision of labour camps				
	vii) Storage of materials				
	viii) Initial maintenance (During Defects Liability)				
	ix) Providing water/electricity for the works				
	x) Protection of the works/materials				
	xi) Clearing away on completion				
	xi) Clearing away on completion.				
	Total for Bill No. 2 C/F to Summary Page for Cener	ator Tr	nstallat	tions	_
	Total for Din 110, 2 C/F to Summary 1 age 101 Gener	ator II	mana		-

## SUMMARY PAGE

ITEN	DESCRIPTION	AMOUNT
NO.		(Ksh Cts.)
1.00	Bill No. 1: Prime rated Generator Installations	
2.00	Bill No. 2: General Items	
3.00	Sub-total	
	Total Amount Carried to Summary Page for Generator Installations and Associated Services	

\_

Total Amount in words \_\_\_\_\_\_

Tenderer's Name and Stamp	
Signature	Date
PIN No	VAT No
Witness	Address
Signature	Date

### BILL NO 1 : LECTURE ROOMS AND ADMINISTRATION BLOCK.

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOU	UNT
NO.	CCTV SVSTEM	•			KShs.	Cts.
	Procurement, Installation and Commissioning of the CCTV Cameras and Video Surveillance Systems.					
1.1	Indoor Dome Cameras 12VDC, 1/3" Progressive Scan CMOS HD, Full HD (1080P) at 25/30fps, dual-stream encoding with H.264 Primary stream, Varifocal SR Lens 3.8 to 13 mm, HDR, Auto Iris, Auto back focus, Micro SD support upto 2Tb, PoE; iDNR; iAE; ROI; day/night with ICR; IVA; Password protected Access; 16:9 Aspect Ratio and 9:16 upright format support.	13	No			
1.2	PTZ Cameras <sup>1</sup> / <sub>4</sub> " CCD Sensor Technology. Full HD Up to 36x optical zoom lens (3.4–122.4 mm) F1.6 to F4.5 with up to 12x digital zoom. Pan-tilt speed up 0.1° to 400° per second. Optical FoV 1.7° to 57.8°; SDXC Recording support (MICRO SD EXCLUDED). Dual H.264/MJPEG streaming; Special application keyboards for PTZ control (EXCLUDED); WDR, SNR at least 40dB; On-click, motion and rule-triggered auto tracking; IK10 protection rating.	1	No			
1.3	Software Channel License per Camera	1	Item			
1.4	Video Recording and Management Manage over 50 cameras spanning multiple sites/distributed architecture; Cameras IVA management. VMS complete with Non- renewable licenses. Batch Camera Firmware upgrade support.ONVIF, RTSP or JPEG protocols on 3rd Party cameras supported.	1	No			
1.5	DIVAR IP 3000 appliance with 24Ch (4TB) pre-licensed fully functional with MS WSS 2008 R2 (64-bit); Video Management System; Bosch Video Recording Manager including Video Streaming Gateway; Dynamic Transcoding. Graphics card (1 x USB DVI port, onboard graphics VGA port). 4 Bay mini tower unit with 2x2TB.	1	No			
1.6	Gigabit PoE 4 24 port Managed Switches	1	No			
1.7	Gigabit high speed Router	1	No			
1.8	Monitor, Full LED Backlit 42" 1920*1080 with 2 HDMI, 2USB support.	1	No			
1.9	Monitor, Full LED Backlit 24" 1366*768 with 2 HDMI, 2USB support.	1	No			
1.1	Decoder for Monitors complete with licences	2	No			
1.11	UTP CAT 6A Cables	10	Box			
	Total for CCTV System Installations For Lecture rooms and add	ministr	ation bl	ock		-

# **BILL NO. 2 LABORATORY AND LECTURE ROOMS**

ITEM	DESCRIPTION	оту	UNIT	RATE	AMOU	JNT
NO.		119	UINII	KATE	KShs.	Cts.
2.1	CCTV SYSTEM Procurement, Installation and Commissioning of the CCTV Cameras and Video Surveillance Systems Indoor Dome Cameras 12VDC, 1/3" Progressive Scan CMOS HD, Full HD (1080P) at 25/30fps, dual-stream encoding with H.264 Primary stream, Varifocal SR Lens 3.8 to 13 mm, HDR, Auto Iris, Auto back focus, Micro SD support upto 2Tb, PoE; iDNR; iAE; ROI; day/night with ICR; IVA; Password protected Access; 16:9 Aspect Ratio and 9:16 upright format support.	4	No	-		-
2.2	DIVAR IP 3000 appliance with 12Ch (4TB) pre-licensed fully functional with MS WSS 2008 R2 (64-bit); Video Management System; Bosch Video Recording Manager including Video Streaming Gateway; Dynamic Transcoding. Graphics card (1 x USB DVI port, onboard graphics VGA port). 4 Bay mini tower unit with 2x2TB.	1	No			
2.3	Gigabit PoE 4 12 port Managed Switches	1	No			
2.4	Gigabit high speed Router	1	No			
2.5	Monitor, Full LED Backlit 42" 1920*1080 with 2 HDMI, 2USB support.	1	No			
2.6	Monitor, Full LED Backlit 24" 1366*768 with 2 HDMI, 2USB support.	1	No			
2.7	UTP CAT 6A cables	2	Box			
	Total for CCTV System Installation Works					_

# **BILL NO. 3 WORKSHOP BLOCK**

ITEM	DESCRIPTION	ΟΤΥ	UNIT	RATE	AMOU	JNT
NO.		Q11	UIII	RAIL	KShs.	Cts.
3.1	CCTV SYSTEM Procurement, Installation and Commissioning of the CCTV Cameras and Video Surveillance Systems Indoor Dome Cameras 12VDC, 1/3" Progressive Scan CMOS HD, Full HD (1080P) at 25/30fps, dual-stream encoding with H.264 Primary stream, Varifocal SR Lens 3.8 to 13 mm, HDR, Auto Iris, Auto back focus, Micro SD support upto 2Tb, PoE; iDNR; iAE; ROI; day/night with ICR; IVA; Password protected Access; 16:9 Aspect Ratio and 9:16 upright format support.	7	No			
3.2	DIVAR IP 3000 appliance with 24Ch (4TB) pre-licensed fully functional with MS WSS 2008 R2 (64-bit); Video Management System; Bosch Video Recording Manager including Video Streaming Gateway; Dynamic Transcoding. Graphics card (1 x USB DVI port, onboard graphics VGA port). 4 Bay mini tower unit with 2x2TB.	1	No			
3.3	Gigabit PoE 4 24 port Managed Switches	1	No			
3.4	Gigabit high speed Router	1	No			
3.5	Monitor, Full LED Backlit 42" 1920*1080 with 2 HDMI, 2USB support.	1	No			
3.6	Monitor, Full LED Backlit 24" 1366*768 with 2 HDMI, 2USB support.	1	No			
3.7	UTP CAT 6A Cables	5	No			
3.8	5 KVA UPS As APC or approved equivalent	1	No.			
	Total for CCTV System Installation Works					-

# **BILL NO. 4 HOSTELS**

ITEM	DESCRIPTION	оту	UNIT	RATE	AMOU	JNT
NO.		×11	orun		KShs.	Cts.
4.1	CCTV SYSTEM Procurement, Installation and Commissioning of the CCTV Cameras and Video Surveillance Systems Outdoor Bullet Cameras Vandal Resistant, tamper detection, 12VDC, 1/3" 1.3MP Progressive Scan CMOS, Full HD (1080P) at 25/30fps, dual-stream encoding with H.264 Primary stream, Varifocal Lens 3.8 to 13 mm, HDR, Auto Iris, Auto back focus, Micro SD support upto 2Tb;IP66, >IK10, PoE; iDNR; iAE; ROI; day/night with ICR; IVA; Image stabilization:	8	No			
4.2	DIVAR IP 3000 appliance with 12Ch (4TB) pre-licensed fully functional with MS WSS 2008 R2 (64-bit); Video Management System; Bosch Video Recording Manager including Video Streaming Gateway; Dynamic Transcoding. Graphics card (1 x USB DVI port, onboard graphics VGA port). 4 Bay mini tower unit with 2x2TB.	2	No			
4.3	Gigabit PoE 4 24 port Managed Switches	1	No			
4.4	Gigabit high speed Router	1	No			
4.5	Monitor, Full LED Backlit 42" 1920*1080 with 2 HDMI, 2USB support.	2	No			
4.6	Monitor, Full LED Backlit 24" 1366*768 with 2 HDMI, 2USB support.	2	No			
4.7	UTP CAT 6A Cables	10	No			
4.9	5 KVA UPS As APC or approved equivalent	2	No.			

# BILL NO. 5 KITCHEN AND DINING

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT KShs Cts
110.	CCTV SYSTEM				
	Procurement, Installation and Commissioning of the CCTV Cameras and Video Surveillance Systems				
5.1	Indoor Dome Cameras 12VDC, 1/3" Progressive Scan CMOS HD, Full HD (1080P) at 25/30fps, dual-stream encoding with H.264 Primary stream, Varifocal SR Lens 3.8 to 13 mm, HDR, Auto Iris, Auto back focus, Micro SD support upto 2Tb, PoE; iDNR; iAE; ROI; day/night with ICR; IVA; Password protected Access; 16:9 Aspect Ratio and 9:16 upright format support.	6	No		
5.2	DIVAR IP 3000 appliance with 12Ch (4TB) pre-licensed fully functional with MS WSS 2008 R2 (64-bit); Video Management System; Bosch Video Recording Manager including Video Streaming Gateway; Dynamic Transcoding. Graphics card (1 x USB DVI port, onboard graphics VGA port). 4 Bay mini tower unit with 2x2TB.	1	No		
5.3	Gigabit PoE 4 24 port Managed Switches	1	No		
5.4	Gigabit high speed Router	1	No		
5.5	Monitor, Full LED Backlit 42" 1920*1080 with 2 HDMI, 2USB support.	1	No		
5.6	Monitor, Full LED Backlit 24" 1366*768 with 2 HDMI, 2USB support.	1	No		
5.7	UTP CAT 6A Cables	7	No		
5.8	5 KVA UPS As APC or approved equivalent	1	No.		
	Total for CCTV System Installation Works for kitchen and dinir	g bloci	K		

# **BILL NO. 6 EXTERNAL AREAS**

ITEM NO	DESCRIPTION	QTY	UNIT	RATE	AMOUNT KShe Cte
no.	CCTV SYSTEM	┟───┤			<b>ROIIS.</b> U.S.
	Procurement, Installation and Commissioning of the CCTV Cameras and Video Surveillance System				
6.1	Outdoor Bullet Cameras Vandal Resistant, tamper detection, 12VDC, 1/3" 1.3MP Progressive Scan CMOS, Full HD (1080P) at 25/30fps, dual-stream encoding with H.264 Primary stream, Varifocal Lens 3.8 to 13 mm, HDR, Auto Iris, Auto back focus, Micro SD support upto 2Tb;IP66, >IK10, PoE; iDNR; iAE; ROI; day/night with ICR; IVA; Image stabilization:	10	No		
6.2	75 mm diameter 8m high flamingo neck galvanised steel pole buried 1m deep with concrete for the above cameras	10	No		
6.3	DIVAR IP 3000 appliance with 24Ch (4TB) pre-licensed fully functional with MS WSS 2008 R2 (64-bit); Video Management System; Bosch Video Recording Manager including Video Streaming Gateway; Dynamic Transcoding. Graphics card (1 x USB DVI port, onboard graphics VGA port). 4 Bay mini tower unit with 2x2TB.	1	No		
6.4	Gigabit PoE 4 24 port Managed Switches	5	No		
6.5	Gigabit high speed Router	5	No		
6.6	Monitor, Full LED Backlit 42" 1920*1080 with 2 HDMI, 2USB support.	6	No		
6.7	Monitor, Full LED Backlit 24" 1366*768 with 2 HDMI, 2USB support.	1	No		
6.8	UTP CAT 6A Cables	7	Box		
	Total for CCTV System Installation Works				-

ITEM	DESCRIPTION	OTY	UNIT	RATE	AMOUNT
NO.		×	01.11		KSH. CTS.
	Supply, install, test, commission and set to work (To the full			ſ	
	satisfaction of all parties to the contract) the following: -				
	Carry out comprehensive Communications Infrastructure and				
	CCTVEquipment installations testing and analysis, after				
	installations. Prior to testing and commissioning conduct				
	comprehensive programming of the system by approved				
	manufacturer's representative to perform as instructed by the				
	Engineer, including ringing patterns The testing and commissioning				
	will be done as detailed below.				
	i) Drive to commence operate of the most the contractor shall				
	1) Prior to commencement of the work the contractor shall submit a presedure for the inspection testing and commissioning of				
	the system. This procedure shall include for the visual and				
	functional check/test of all components of the system the visual				
	check will cover the standard of workmanshin the functional				
	quality of the equipment and general compliance with the system				
	specification and the functional tests shall check the operation of				
	the system as a whole				
	ii) Commissioning will be undertaken by a qualified person				
	using the approved inspection, testing and commissioning				
	procedure.				
	iii) On successful commissioning of the system, in terms of				
	the specified requirements, a Taking Over Certificate shall be				
	completed. This is the written notification to the Service				
	Provider/installer that the client has taken over the system in terms				
	of the Agreement. Payment cannot be effected without this				
	certificate				
	(v) The Final Completion date for the system is determined				
	from the Hand over Certificate. The taking over date is also that				
	date on which the warranty period is deemed to have commenced.				
	y) Each equipment in the installations shall be supplied with				
	a complete installation manual and comprehensive operating				
	instructions. In addition, cabling and wiring information, a list of all				
	equipment with associated serial numbers, etc (as specified) and any				
	other information that may be required by the client from time to				
	time and a copy of the taking Over Certificate shall be provided in a				
	A4 hard cover arch lever type file				
L					
	vi) The contractor shall provide basic operating training on				
	the system, using the operating instructions, for client staff prior to				
	the Taking over Certificate being issued. This training shall be				
	sufficient to ensure correct operation of the system. The contractor				
	shall issue certificates to certify that the operators are proficient in				
	the operation of the system on successful completion of the system				
	training. This training MUST be in the manufacturer's				
	representative s presence				
I					

## BILL NO. 7 – GENERAL ITEMS

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					KSH. CTS.
10.	<ul> <li>vii) The above documentation shall be handed to a selected client representative at the time of commissioning. The documentation to be as detailed below:-</li> <li>viii) System Documentation - all documentation relating to the installation shall be concise, complete and unambiguous. Information shall be provided sufficient to install, test and commission, operate and maintain the system. Operating instructions shall be designed to minimize the possibility of incorrect operation of the system.</li> <li>ix) Component documentation - documentation relating to the components of the installation system shall also be concise, appropriate and unambiguous.</li> </ul>				
	<ul> <li>complete and unamorguous. Sufficient information shall be provided to ensure the integration of the component with any other of the system's components. Component documentation shall include the following:-</li> <li>c) Standard to which component claims compliance.</li> <li>d) Name or mark of the cartification body.</li> </ul>				
7.01	Acquire and submit a Bank Guarantee for 5% of the sub-contract sum, as a Performance Guarantee.		Item		
7.02	Acquire and submit Insurance for the sub-contract work.		Item		
7.03	Allow for presentation of all the required samples as per specifications, Bills of Quantities and Drawings.		Item		
7.04	Prepare and submit Working Drawings as follows:-				
	<ul> <li>i) Draft soft copy in Archicad® and Autocad® 2000 in CD-RW.</li> <li>ii) Amended soft copy in Archicad® and Autocad® 2000 in CD-RW.</li> <li>iii) 5 Final soft copies in Archicad® and Autocad® 2000 in CD-RW to Architect, Client, Quantity Surveyor, and Engineer (2 copies)</li> </ul>				
7.05	As item no. 9.04, but for Record (As-Installed) Drawings comprising:				
	<ul> <li>Fully dimensioned drawings of all plants and apparatus.</li> <li>General arrangement drawings of equipment, plant etc.</li> <li>Routes – types and sizes and arrangement of all pipework.</li> <li>System schematics and trunking diagrams showing all salient information relating to control and instrumentation.</li> <li>Grading charts</li> <li>Wiring and piping diagrams of plant and apparatus.</li> <li>Schematic diagram of individual plants and switch and control boards.</li> </ul>				
	Total C/F toNext page				

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
NO.					KSH. CTS.
	Total B/F from previous page				-
7.06	Provide a year's (12 months') initial maintenance upon expiry of the Defects Liability Period. The maintenance to be carried out every quarter (3 months) for a period of 12 months.		Item		
7.07	All other items of general preliminary to cover, but not limited to:-				
	<ul> <li>Attendance on all other sub-contractors, such as for UPS</li> <li>Installations, Structured LAN Cabling, Fire Detection and Alarm</li> <li>System, Electrical Installations, Audio Visual Installations,</li> <li>Generator Installations, Lift Services, Solar Water Heating, V-Sat</li> <li>services etc.</li> <li>Hiring and keeping a Supervisor/Foreman on site</li> <li>Constant supervision of the works.</li> <li>Provision of all the required spares.</li> <li>Testing and Inspection of materials/works.</li> <li>Provision of labour camps.</li> <li>Storage of materials.</li> <li>Initial maintenance (During Defects Liability)</li> <li>Protection of the works/materials</li> <li>Clearing away on completion.</li> <li>Preparing Final Account.</li> <li>Providing all Test Certificates, etc.</li> </ul>	Item			
	rotarior General rients Carrieu Porwaru to Summary Page				

	SUMMARY PAGE		
ITEM	DESCRIPTION	AMO	UNT
NO.		KShs.	Cts.
1	BILL NO 1 : LECTURE ROOMS AND ADMINISTRATION BLOCK.		-
2	BILL NO. 2 LABORATORY AND LECTURE ROOMS		-
3	BILL NO. 3 WORKSHOP BLOCK		-
4	BILL NO. 4 HOSTELS		-
5	BILL NO. 5 KITCHEN AND DINING		-
6	BILL NO. 6 EXTERNAL AREAS		-
7	GENERAL ITEMS		
	TOTAL FOR CCTV INSTALLATIONS C/F TO SUMMARY PAGE FOR ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVICES		

#### PROPOSED KENGEN GEO- THERMAL TRAINING CENTER (GTC), OLKARIA- NAIVASHA BILL OF QUANTITIES FOR GRID TIED SOLAR HYBRID SYSTEM INSTALLATIONS

#### BILL NO 1 SOLAR HYBRID SYSTEM

ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
NO.				MIL	millouiti
1.00	Supply and install the following as per the particular technical specifications or equal and approved:				
1.0(a	330w <sub>p</sub> solar monocrystalline photovoltaic module as <i>Kyocera KD330GX-LFB or equal and approved equivallent</i>	No	32		
1.0(b	15 KVA pure sine wave string inverter, weather proof IP66 as <i>Sunny</i> <i>Tripower 25000TL or equal and approved equivallent</i>	No	1		
1.0(c	10KVA pure sine wave inverter/charger as <i>Sunny Island 8.0H- or</i> <i>equal and approved equivallent complete with</i> power monitoring and control accessories	No	3		
<b>1.10</b> 1.1(a	<b>D.C Cabling-Solar Array and Inverter</b> 2 core 6 sqmm pvc/pvc UV protected copper cable from the solar pv array to the DC combiner box complete with cable lugs and glands	LM	120		
1.1(b	2 core 6 sqmm pvc/pvc UV protected copper cable from the DC combiner box to Inverter complete cable lugs and glands	LM	60		
1.1(c	4 way DC combiner box complete with the following fuses	Item	1		
i	15A 1000Vdc fuse	No	3		
ii	60A 1000Vdc fuse	No	1		
iii	DC Surge protection device	No	1		
<b>1.20</b> 1.2(a	A.C Cabling 4 core 10 sqmm pvc/swa/pvc cu cable between the string inverter and AC input D.B	Lm	80		
1.2(b	3 core 10 sqmm pvc/swa/pvc cu cable from the three inverter/charger to AC output DB	Lm	80		
1.2(c	3 core 10 sqmm pvc/swa/pvc cu cable from the sub board to the inverter/charger AC input	Lm	75		
1.2(d	63A TPN three position metal clad manual by pass as Schneider/ABB or an approved equivallent	No	1		
1.2(e	63A SPN moulded case isolator between the Multi Cluster Box and inverter charger as schneider/ABB or an approved equivallent	No	3		
1.30 <b>1.3(a</b>	AC Input DB 4 way TPN surface mounted distribution board complete with 125A TP isolator as Schneider Electric Acti 9	No.	1		
1.3(b	Miniature Circuit Breakers as Schneider Acti 9				
( i	204  SP 10kA  type C MCB	No	3		
::	Loballing of outgoing circuits	Itom	5		
11	Labering of outgoing circuits	item	σ		
iii	Labelling of the distribution board using traffolyte engraved labels	Item	1		
	Tota] C/F To next nage				

### PROPOSED KENGEN GEO- THERMAL TRAINING CENTER (GTC), OLKARIA- NAIVASHA BILL OF QUANTITIES FOR GRID TIED SOLAR HYBRID SYSTEM INSTALLATIONS

#### BILL NO 1 SOLAR HYBRID SYSTEM

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
110.	Total brought forward from previous page				
1.40	AC Output DR				
1.40 1.4(a	12 way TPN surface mounted distribution board complete	No.	1		
	with 125A TP isolator as <i>Schneider Electric Acti 9</i>				
1.4(b	Miniature Circuit Breakers as Schneider Acti 9				
i	40A TP 10kA type C MCB	No.	8		
ii	Labelling of outgoing circuits	Item	6		
iii	Labelling of the distribution board using traffolyte engraved labels	Item	1		
1.50	Solar P.V Support system				
	Solar P V flat roof mount system to carry 14No 330Watts PV	item	1		
	modules at an angle of $10^{\circ}$ consisting of aluminium rails.				
	intermodule clamps and end clamps to secure the panels onto the rails.				
1.60	Cable Tray and Trunking				
1.6(a	250X25mm galvanized cable tray complete with mounting brackets to	Lm	50		
1.64	be installed at 1m interval	т	20		
1.6(b	250 X 50mm stove enamelled, oven baked 3 compartment rectangular	Lm	30		
	approval				
1.70	Earthing and Bonding				
	6sqmm single core Green & yellow PVC insulated stranded copper	LM	50		
	cable BS EN 50525 as East African Cable 6491X bonded to the main				
	TOTAL FOR SOLAR INSTALLATIONS C/F TO SUMMARYPA	GE FO	R		
	ELECTRICAL INSTALLATIONS AND ASSOCIATED SERVIC	ES.			

#### MAIN SUMMARY

ITEM NO.	DESCTIPTION	TOTAL (KSHS)
1	Total For Electrical Installations	
2	Total For Structured Cabling Installation	
3	Total For Generator Installation	
4	Total For Passenger lift Installation	
5	Total For CCTV Installation	
5	Total For Solar Hybrid Installation	
	Total C/F To grand summary in Vol. 2	

Total Amount in words	
Tenderer's Name and Stamp	
Signature	Date
PIN No.	VAT No.
Witness	Address
Signature	Date