

**HEUWELLAND PRIMARY SCHOOL
ELECTRICAL INSTALLATION
FOR
DEPARTMENT OF EDUCATION
IN THE
KING CETSHWAYO DISTRICT
FOR THE
DEVELOPMENT BANK OF SOUTH AFRICA
PROVINCE OF KWAZULU-NATAL**

SECTION 1: GENERAL ELECTRICAL SPECIFICATION

SECTION ONE

GENERAL TECHNICAL SPECIFICATION FOR
ELECTRICAL INSTALLATIONS

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GENERAL TECHNICAL SPECIFICATION FOR ELECTRICAL INSTALLATIONS

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1 CONDUIT AND CONDUIT ACCESSORIES

1.1 Conduit

Conduit shall be plain-ended UPVC, black enamelled or galvanised mild steel, internally and externally, either solid drawn or welded, not less than 20mm diameter, and with all rough edges removed. All cut conduit ends are to be reamed. Screwed conduit shall be threaded at both ends and supplied with a coupling at one end and the other protected against damage by means of a PVC cap.

General requirements for conduits according with SANS 60614-2-5.

Metal conduits shall be fully in accordance with SANS 1065-1.

UPVC conduit shall be fully compliant with SANS 950.

1.2 Conduit Accessories

Conduit accessories shall be of the same material as the conduits to which they are to be attached i.e. UPVC accessories for UPVC conduit galvanised metal accessories for galvanised conduit etc.

Where fittings are fitted with covers, the covers shall be of the same material as the respective fittings and shall be secured with brass screws.

Conduit accessories that are secured to the conduit by means of lugs, screws, clamps or PVC tape will not be accepted.

1.3 Flexible Conduit

Flexible conduit shall be of the plastic covered metal type complete with brass connectors to the approval of the Engineer.

2 INSTALLATION OF CONDUIT

2.1 General

Except where cables are specified for certain circuits, the installation(s) shall be tubed throughout in conduit. All conduits shall be UPVC and concealed in the structural work wherever possible, or unless otherwise specified or approved by the Engineer.

Except where agreed, or otherwise specified or indicated on the drawings, all conduits to points shall run via the ceiling and floor slab or roof space. In damp situations and where exposed to the weather, the conduits shall be so installed as to avoid, as far as possible, the condensation of moisture within them.

Mechanical and Electrical continuity must be maintained throughout the installation. Each length of conduit and every conduit fitting must be inspected for defects and all sharp edges or burrs must be removed before it is installed. All joints are to be tightly fitted together.

In Conduits smaller than 32mm, elbows and normal bends are not to be used but conduits are to be set to the required angles.

Flexible connections between conduit and appliance or other equipment shall be by means of flexible conduit.

No wiring shall be drawn into conduits until the conduits have been installed.

Where more than one socket outlet is connect on a circuit, the conduit shall be looped from one outlet box to the following outlet box.

All conduits shall be securely fixed into chases, and all flush switch and socket outlet boxes must be firmly embedded in cement mortar.

The Contractor shall make himself familiar with the positions of all fittings, such as blackboards, pinning boards, cupboards, shelving, work-tops, etc, before commencing the conduit installation. The position of switches and socket outlets as indicated on the drawings are approximate only. The Contractor must verify that the final position of these will not be covered by the installation of the fittings referred to above, or come midway between the junction of any dadoes and upper wall finishes.

Claims for additional work for moving switches or socket outlets as a result of the Contractor's failure to verify the final positions of the fittings or type of wall finish will not be entertained.

2.2 In Roof Spaces

Conduit in roof spaces shall be installed parallel or at right angles to the roof truss members and shall be secured at centres not exceeding 1200mm by means of galvanized saddles nailed to the timbers with galvanized clout nails. Crampets will not be allowed.

Crossing of conduits is to be avoided wherever possible. Where unavoidable, one conduit must be neatly set over the other. Where a number of conduits have to run back to the distribution board or switchboard, they shall run parallel to the distribution board or switchboard, and at saddle distance to each other wherever possible.

Conduit runs from distribution boards shall terminate in fabricated sheet steel draw boxes installed in the roof above the distribution boards. Each draw box shall be fabricated from 1.60mm galvanized sheet steel with welded corners and suitably treated against corrosion with "Rustodian" or other approved primer and finished in aluminium paint.

Each draw box is to be fitted with a slip-on lid with a 13mm skirt. The box shall be 75mm deep, rectangular in shape and of sufficient dimension to accommodate the number and sizes of conduits entering or leaving the box. Conduits shall be fixed to the box by means of adaptors, couplings and brass male bushes or lock nuts and brass bush-nuts, as applicable to the type of conduit being installed.

Conduit droppers shall be neatly cut into timber wall plates and set to face the right direction. All sets must be uniform. Conduits may be at set angles only where droppers or ceiling points are within 230mm of roof members.

No conduits are to be run over the top of gangplanks or trapdoors.

Draw-in boxes with metal cover shall be provided where required and shall be installed near the gangplanks, if any. All inspection conduit fittings in open roof places shall face upwards to facilitate wiring and to permit easy inspection. Three-way conduit boxes shall be used for tee-off purposed in open roof spaces. Inspection tees are not to be used except where otherwise agreed or specified.

Any conduits extended into a roof space with a roof clearance of less than 900mm shall be set onto the beams and extended into the roof for a distance to where there is sufficient clearance. Under flat roofs, or where there is less than 900mm clearance, the conduit shall be installed as specified for tubing in concrete slabs; right angle bends should be kept to a minimum and the shortest route taken.

Where false ceilings occur, they shall be tubed as called for in the detailed specification. Conduits in restricted spaces and run as for concrete slabs must however, be installed in a neat and orderly manner.

Conduits to ceiling points for all types of fittings must be firmly supported and shall terminate in back entry conduit boxes. The conduit boxes shall be taken through to the face of the ceiling and finish flush. Where the ceiling brander interferes with the installation of the ceiling point specified, the Contractor must trim or adjust the brander, in conjunction with the Building Contractor, to allow the conduit box to be taken through to the face of the ceiling as specified.

Where screwed conduit is installed the luminaires must be attached to the conduit boxes by means of threaded metal screws.

Where screwed metal conduit is installed, no threads will be permitted to show when the conduit installation is complete, except on running couplings. Running couplings shall only be used where unavoidable and shall be fitted with a sliced coupling for a lock nut

2.3 In Concrete Slabs

In order not to delay building operations, the Contractor must ensure that all conduits and conduit fittings, which are to be cast in concrete, are laid in good time. The contractor shall have a competent Electrical Artisan standing by during casting of concrete, etc, to ensure that the conduit boxes are not damaged during casting of concrete.

Draw boxes, expansion joints boxes and round conduit boxes are to be provided where necessary.

Where crossings of conduits are unavoidable and may not be covered, above and below, by a sufficient thickness of concrete, purpose made metal boxes shall be used. The length of the box is to be 8 times the diameter of the largest conduit, the width, one and a half times the sum of the diameter of all the conduits, and the depth, one and a half times the diameter of the largest conduit. The box shall have a minimum depth of 50mm and shall be fitted with a neatly fitting cover, the finish of which shall be in keeping with the general layout.

2.4 Surface Work

Conduits installed on surface shall be galvanised mild steel and shall be installed horizontally or vertically unless dictated otherwise by a building detail or approved by the Engineer.

Where a number of conduits are to be installed in parallel, they shall be evenly spaced and grouped under one purpose made saddle. The spacing shall not exceed 10mm. The purpose made saddle shall be made of 25mm x 2mm galvanized steel strip or other approved material, formed to suit the curvature of the various conduits and shall be drilled and fixed by means of screws between.

Saddles shall be spaced at intervals not exceeding 1.8m, except for conduit droppers, which shall be saddled centrally between ceiling and accessory box. All saddles are to be secured to the wall by means of plastic wall plugs and “black japan” or round head brass screws.

Distribution boards, draw boxes, industrial switches and plugs etc, shall be neatly recessed into the plastered walls to avoid double sets or alternatively spacer bar saddles may be used. On face brick walls, the conduit shall be tightly set into the switches or plugs etc.

Double sets, where used, shall be parallel, with no twists and shall be as short as possible. All conduits, which terminate at metal trays, boxes, industrial switches and plugs etc. shall do so by means of couplings and male bushes. No couplings will be permitted in droppers of lengths less than 3600mm.

Where spacer bar saddles are used, these shall be installed at centres of 1000mm for horizontal and 1500mm for vertical runs.

All conduits shall be painted with an approved enamel paint to match the background colour.

2.5 Future Extensions

In roof spaces with a clearance of less than 900mm, conduits for extension to future switch and plug drops shall be set 300mm in the correct direction and shall be plugged to prevent the ingress of foreign matter or moisture.

Where the roof over a slab is to be removed for future expansions, conduits for future use shall be terminated 40mm above the top of the beams or slab and shall be plugged and sealed to prevent the ingress of foreign matter or moisture.

Where future extensions are to be below slabs, all conduits for droppers to switches, socket outlets etc. shall be terminated 130mm below the slabs or beams with conduit ends plugged and sealed.

Where provision is made for future extensions to a concrete slab, all conduits required for future use shall be installed so as to project 130mm from the end of the slab and shall be plugged and sealed. Metal conduit projections shall be painted with an approved anti-corrosive paint and shall be plugged and sealed.

All outlet boxes built into the structure and intended for future switches, plugs etc. shall be fitted with approved blank PVC cover plates.

Unused lighting outlet boxes shall be fitted with round metal or PVC covers, as applicable, with brass cover screws and shall fit flat on the finished ceiling.

2.6 Fixing of Conduits

Conduits shall be fixed to boxes for switches, socket outlet etc. by means of adaptors, couplings and brass male bushes, or lock nuts and brass bush nuts, as applicable. Couplings and male bushes are to be used on all surface mounted equipment.

2.7 Chases and Building Work

Except where otherwise specified, conduits, switch boxes, plug boxes, distribution board trays etc., shall be built into the brick walls by the Contractor. It will, however, remain the responsibility of the Main Contractor to ensure that the above-mentioned boxes and distribution boards are correctly built in and are firmly bedded and cemented, plumb and square, into the walls.

The Contractor shall, unless otherwise specified, do all necessary chasing and cutting of brickwork. All electrical materials (e.g. conduits up to 50mm for UG cables, conduits, conduit boxes, distribution boards etc) must be supplied by the Contractor who must arrange to have these on site, and positioned when required for the building work. A competent Electrical Artisan must be in attendance and ensure that the conduits etc. are correctly installed and positioned.

The Contractor is to ensure that tubing installed in chases is securely nailed and covered by a layer of 5:1 mixture of coarse sand and cement, finished flush with brickwork and that switch and plug boxes finish flush with the finished wall surface.

Where the Contractor is responsible for cutting of chases and building in on conduits or other equipment, he will be held responsible for all damage as a result of this work, and shall be required to make good to the satisfaction of the Engineer.

The Contractor is to ensure that, where a flush mounted distribution board is connected by means of underground cable, a 230mm wide by 115mm deep cavity is provided in the wall below distribution board, from the cable pipe to the distribution board, is by the Main Contractor. Alternatively, cable sleeves as specified. Cable sleeves shall be installed as specified.

3 PLUGGING OF WALLS

Only approved plastic wall plugs shall be used to secure conduit or equipment up to 5kg mass per plug. The use of round-headed screws only will be permitted.

Heavier equipment shall be secured by means of approved expansion bolts.

Wood plugs and any plugs in the joints in brick walls will not be permitted.

4 FIXING TO CONCRETE CEILINGS

Ceiling mounted equipment other than luminaires shall be secured to concrete ceilings by means of expansion bolts, shot bolts or “Robot” tools bolts or as expressly specified for the service.

5 WIRING

Wiring shall be carried out with single core PVC insulated stranded copper conductor cable rated at 1000 Volts. The cable shall be finished in the required colours and shall be in accordance with SANS 1507 and 1574-3-5.

Circuit wiring shall be of the “Loop-In“ system and wiring joints in the conduit or conduit fittings will not be permitted. Not more than two conductors of a kind will be allowed at any outlet point. The end strands of cables, whether single or looped, which have to be connected to terminals of switches, plugs, lamp-holders, fittings and distribution boards, etc. shall to be tightly twisted together. Cutting away of wire strands of any cable will not be allowed. Only one circuit will be allowed in any one conduit unless otherwise specified or approved by the Engineer.

Conductor sizes shall be as follows except where otherwise specified.

Lighting circuits	1,5mm ²	with 2,5mm ² insulated earth wire
Plug Circuits	2.5mm ²	with 2,5mm ² insulated earth wire
Geyser circuits	4,0mm ²	with 2,5mm ² insulated earth wire
Heater circuits	4,0mm ²	with 2,5mm ² insulated earth wire
Stove	10,0mm ²	with 6,0mm ² insulated earth wire
Motor circuits		
Up to 4kW single phase	4,0mm ²	with 2,5mm ² insulated earth wire
Up to 11kW three phase	4,0mm ²	with 2,5mm ² insulated earth wire

For motors of a higher rating, wiring shall be accordance with the relevant tables of the SANS 10142-1.

To avoid deformation of PVC insulated cables at temperatures in excess of 57°C, they shall not be brought directly onto the terminals of appliances such as electric heaters, or any other electrical appliances or apparatus (including luminaires) which have a temperature in excess of 57°C. The conductors shall terminate in a suitable terminal box as near to the appliance or fitting as possible and connect thereafter by means of flexible cable with heat resistant insulation.

6 MOUNTING AND POSITIONING OF LUMINAIRES

Luminaires and installation thereof shall comply with SANS 1065-2, 1464 Parts 1 to 22 and IEC 598 – 1 and IEC 60598 as applicable.

The Contractor shall in the case of board and acoustic tile ceilings (i.e. as opposed to concrete slabs) ensure that the luminaires are symmetrically positioned with regard to the ceiling pattern.

The layout of the luminaires as indicated on the drawings shall be adhered to as far as possible. The exact positions must be confirmed on site with the Engineer.

Except where otherwise specified, pendant luminaires are to be mounted with the bottom of the fittings 2400mm above finished floor level, mounted on either metal discs or wood blocks.

Under no circumstances shall cover strips be cut to accommodate wood blocks. Wood blocks must be neatly slotted to fit over cover strips and shall be secured by a minimum of two wood

screws, which shall penetrate at least 25mm into solid wood positioned behind the ceiling board. Ceiling cover strips shall be neatly cut to accommodate fluorescent luminaires.

Where ceilings are raked, all incandescent luminaires are to be mounted on shaped levelling wood blocks or other approved purpose made galleries securely fixed to the ceiling. Batten holders shall be secured to woodblocks by suitable brass screws. Fluorescent luminaires are to be mounted direct on raked ceiling without levelling blocks.

Fluorescent luminaires to be mounted on concrete ceilings shall be screwed to the outlet boxes and additionally supported by means of plastic plugs and 50mm x 6mm wood screws with oversize (fender) washers. The screws shall be $\frac{3}{4}$ of the length of luminaires apart.

Where a number of luminaires are installed end to end, outlet points must be provided after every second luminaire unless otherwise indicated on the drawing. The luminaires are to be joined together by means of 20mm conduit nipples, lock nuts and brass female bushes, and the wiring led through the channels of the luminaires. The Contractor shall ensure that all such rows are correctly lined up and that the rows are parallel with the relevant building line.

Incandescent luminaires are to be screwed directly to outlet boxes in concrete slabs and in board ceilings. In board ceilings, the conduit box and the conduit shall be secured to the timberwork of the ceiling in such a manner that it shall support any incandescent luminaire, which is designed to be fixed to a normal conduit box.

Fluorescent luminaires shall be secured to board ceilings by means of the conduit box as well as 50mm x 6mm round head wood screws with oversize (fender) washers that shall pass through the boards and into additional brading which shall be installed for this purpose.

7 BATTEN HOLDERS

B.C. Batten holders shall be of brass or moulded plastic reinforced type complete with shade ring. The batten holders shall comply with SANS 60238 and SANS 61184. All lamp holders are to have brass screw type connection terminals.

8 LAMP HOLDERS

Edison Screw lamp holder	: SANS 60238
Bayonet Cap lamp holders	: SANS 61184
Lamp holders for tubular fluorescent lamps	: SANS 60400

Lamp holders for fitting directly onto screwed conduit shall be of brass 20mm E.T. complete with shade rings and shall comply with SANS 60238 and SANS 61184 with screw type connection terminals.

9 SWITCHES AND SOCKET OUTLETS

Switches SANS 60669-2-1, VC 8003 as applicable and socket outlets SANS 164-3, VC 8008 as applicable shall be of the most modern manufacture and bear the SANS mark.

Flush switch and plug cover plates shall, unless otherwise specified, be of PVC, white or other approved finish as directed and otherwise to be fully in accordance with SANS 1084 for cover plates and SANS 1085 for wall boxes. All flush switch and plug and isolator cover

plates shall be engraved depicting the distribution board and circuit number of a particular circuit.

Cover plates for socket outlets connected to the “Normal Supply” circuits shall be White in colour, Red in colour for “Clean Line” (dedicated) circuits, Blue in colour for “UPS Supply” circuits and Black in colour for “Emergency (standby generator) Supply” circuits.

Socket outlets connected to the “Normal Supply” circuits shall have earth sockets that accept plug tops with round earth pins (standard type of socket outlet).

Socket outlets connected to the “Clean Line” (dedicated) circuits shall have earth sockets that accept plug tops with “Horizontal Flat” earth pins (dedicated type of socket outlet).

Socket outlets connected to the “UPS Supply” circuits shall have earth sockets that accept plug tops with “Right Hand Diagonal Flat” earth pins (dedicated type of socket outlet)

Socket outlets connected to the “Emergency (standby generator) Supply” circuits shall have earth sockets that accept plug tops with “Left Hand Diagonally Flat” earth pins (dedicated type of socket outlet)

10 POSITIONS OF SWITCHES AND SOCKET OUTLETS

Except where otherwise specified or indicated on the drawings, lighting switches shall be installed at 1400mm above finished floor level and socket outlets at 500mm above finished floor level.

All mounting heights specified are to be measured from finished floor level to the bottom of the outlet box.

Where the lower portion of the wall consists of face brickwork and the upper portion of plastered finish, switches and socket outlets are to be mounted in the plastered surface, provided that the lower edge of the plasterwork does not exceed a height of 1500mm above finished floor level, in which case, the switches or socket outlets are to be installed in the face brick dado.

Where socket outlet and switch boxes have been installed with fixing lugs below finished wall surface only approved distance pieces required to compensate for the recess shall be used. The lengths of distance pieces are not to exceed 15mm.

Unless otherwise approved, light switches adjacent to door are to be installed at the lock side of the door. Where the lock position is not indicated on the drawings, its position shall be ascertained before the switch box is installed. Switches are to be 150mm from the reveal, or centrally if there is a fitting near the door.

All switch and socket outlet boxes shall be installed plumb, and built into the wall with a 1:5 mixture of cement and sand.

Industrial type switches and socket outlets shall be neatly recessed into the surface of the plastered walls to avoid sets or alternatively spacer bar saddles may be used.

Deep type (through) boxes may be used where switches or socket outlet are back to back and on the same circuit. However, where one side only is to be utilized at the time and the other is for future use, the side for future use shall be suitably covered with a metal cover plate.

11 LOW VOLTAGE SWITCHBOARDS

Manufacturers General Arrangement (workshop) drawings indicating the details of construction all switchboard equipment proposed, and which must be approved by the Engineer before manufacture is commenced.

Low voltage switchgear and control gear to comply with SANS 1473, SANS 1765, SANS 1973 and SANS 60439-5.

Low voltage switchboards / distribution boards shall be fitted with surge protection on all phases to comply with SANS 61643-1.

Where switchboards are to be installed in switch rooms or switch cupboards, the Contractor must ensure that the boards are manufactured to suit the dimensions of the rooms or cupboards.

Low tension switchboards shall be specified in detail for each service, but shall generally conform to the following:

They are to be of strong and rigid construction, with suitable angle, channel or folded steel framework. They are to be flush fronted and totally enclosed with sheet steel panels suitably formed at the edges and reinforced to prevent distortion. Unless otherwise directed, all front panels must be at least 2mm thick and all other panels at least 1,6mm thick. Panels are to be secured to the framework with studs and chromium plated dome nuts (self-tapping and similar screws are not permitted).

Switches etc. are to be mounted on metal frames within the boards to give flush front panels. Equipment of normally surface mounted types such as energy meters, time switches and contactors, are to be mounted on inner metal trays behind hinged front panels. In the case of supply authority meters, the hinged front panels must have transparent inserts.

All metal work of the boards must be thoroughly degreased, primed with PA 10 self-etching primer and finished with one coat of undercoat and two coats of electric orange high gloss enamel, unless otherwise specified.

All accessible current carrying parts, bus bars, connecting strips, collector bars, etc are to be adequately insulated in phase colours and suitably braced to withstand projected fault currents.

Connecting strips and collector bars must be of sufficient cross sectional area to carry full rated current of the switches served, irrespective of the fuse or trip rating.

The complete distribution board including bus bars must be suitably constructed to withstand fault currents specified.

Connections to bus bars are to be made by means of lugs suitably bolted and locked with high tensile bolts, and connections to lugs must be effected by means of crimping tools.

Incoming and outgoing bus bar studs, where required, must be suitably insulated where they pass through panels of the board, and firmly supported within the board.

Where applicable, incoming and outgoing collector bars for cables in parallel must be arranged that the multiple cable ends can be connected to the bars with reasonably short tails which do not have to cross.

Cable supports must be placed at suitable heights having regard to the bending radius of the cables concerned and convenience in making of.

Walls-mounting and floor-standing back to wall type boards must be provided with full easy access to all equipment and wiring without any necessity of disconnecting or removing of any of the equipment mounted in the board.

Clear visible indication of all switch positions must be provided and the switches must be clearly labelled as directed by the Engineer.

Current transformers installed in the switchboards and used for metering and maximum demand indicators shall be of the 600 volt Class 1 ring type or other approved by the Engineer.

12 DISTRIBUTION BOARDS

12.1 Flush Mounting Distribution Boards

These shall be generally manufactured in accordance with SANS 1765. The board shall consist of two panels fitted side by side with common bonding tray and attached to a common architrave. One panel shall accommodate all single phase MCBs and the second panel shall accommodate the main isolator; main bus bars and the triple pole MCBs. Chassis shall be of rigid channel section, rust proofed steel with clip-on trays for the single pole MCBs. The main isolator is to be mounted at the bottom of the second panel with the triple pole circuit breakers above.

In general, single-phase boards shall be mounted with the top of the architrave 2000mm above finished floor level and three phase boards with the bottom of the architrave no lower than 1200mm above finished floor level, unless specifically directed otherwise.

12.2 Surface Mounting Distribution Boards

These shall be generally manufactured in accordance with SANS 1765, with two panels as for flush boards.

12.3 Single Phase Distribution Boards

Single-phase boards shall be generally constructed, as three phase boards except they shall have a single panel. Single-phase boards shall be mounted with the top of the architrave 2000mm above finished floor level, unless specifically directed otherwise.

12.4 Distribution Board – Below Roof Spaces

Where distribution boards are installed below a roof space, a minimum of 2 x 20 mm and 1 x 25mm spare conduits are to be run from the distribution board into the roof space.

13 MOULDED CASE CIRCUIT BREAKERS (INCLUDING MINIATURE)

Circuit breakers shall be of the size and type as directed and specified for the service. They shall comply with SANS 156, SANS 556-1, SANS 60947-2 and VC 8036.

14 SWITCHES: ON-LOAD FAULT MAKING (CIRCUIT BREAKER) TYPE WITHOUT TRIPS

The switches shall be triple pole, hand operated, panel mounting air break type, having continuous current rating as specified and suitable for operation on 380-440 Volt 50 Hertz A.C. system.

The contacts are to be of silver alloy and the switch mechanism shall be of the quick-make quick-break type.

15 SWITCHBOARD EQUIPMENT

Switchboard equipment such as switches, circuit breakers etc, shall be as directed and specified in the detail specification for the service. Circuit breaker equipment shall comply with SANS 156, SANS 556-1, SANS 60947-2 VC 8036.

16 FUSE-SWITCH UNITS (WITH H.R.C FUSES)

The fuse switch unit is to be of double pole, or triple pole, or triple pole with neutral link type, and of the required current rating, as specified for the service, and must be in accordance with SANS 5419.

The fuse links must be fully isolated when the switch in the open position, and interlocks must be provided to prevent the switch being operated with the cover open.

The fuse links shall comply with SANS 172 and SANS 60269-1.

17 BUS-BAR COPPER

Bus-bar copper must be fully in accordance with SANS 1195 and SANS 60439-2.

18 SPECIFICATION COMPLIANCE

The complete installation shall comply with the requirements of this specification. Should any differences or contradictions exist between this specification and the detailed requirements for a specific installation, then the detailed requirements shall take precedence.

19 METER BOXES

The meter box shall be of a design acceptable to the Engineer. The Contractor must obtain the approval of the Supply Authority for any meter box intended for use prior to purchase and

installation. The meter box shall be mounted with the top 1700mm above finished ground level. Surface mounted meter boxes shall be secured by at least 4 x 10mm expansion bolts.

Service cables entering the meter box shall be protected by means of a suitably sized galvanized pipe extending 200mm below the ground surface and securely saddled to the wall and bonded to the meter box.

20 CONNECTIONS TO OUTLETS

20.1 General

Where connectors are used for the connection of luminaires and other appliances to the wiring, the connectors shall comply with Section 6 of SANS 10142-1.

20.2 Connections to Stoves

The connection to an electric stove, unless otherwise specified shall consist of 2 x 10mm² conductors and a 6mm² insulated earth wire in 25mm conduit. The stove shall be controlled by a 60 Amp micro gap switch of approved make and the connections shall be by means of a 45 Amp 3 pin stove plug of the "Cape Town" type. Cable ends, which are to be connected to the stove, shall be equipped with suitable soldered or crimped lugs. The connection between the stove plug and stove shall be by means of flexible conduit.

The conduit shall be chased into the wall and fitted with a switchbox for housing the micro gap switch and a 25mm circular conduit box over which the stove plug will be mounted. The stove plug shall be fitted with an adaptor plate and shall be screwed directly to the conduit box by means of round head metal screws. The plug outlet shall face downward.

The stove plug and switch shall be mounted 430mm and 1400mm respectively above finished floor level unless otherwise specified or indicated on the drawings.

20.3 Connections to Hot-Water Cylinders

The connections to hot-water cylinders not exceeding 3kW loading shall consist of 2 x 4mm² PVC conductors and 1 x 2,5mm² earth wire in a 20mm diameter conduit from the distribution board. The conduits shall be chased in the wall and shall terminate at the side of the cylinder in a box over which is to be mounted a double pole isolator with pilot light.

The final connection between the isolator and cylinder shall be by means of silicon heat resistant conductors in 20mm diameter flexible conduit.

Connections to cylinders of greater loadings shall be similarly carried out, but with wiring and conduit sizes selected in accordance with the relevant tables of the code of practice.

Connections to roof mounted hot-water cylinders shall generally be as specified above with an isolator with pilot light mounted adjacent.

20.4 Connections to Power Points

Connections to electric motors and fixed apparatus subject to vibration shall, unless otherwise specified or indicated on the drawings, have final connections consisting of conduit and flexible tubing or reinforced hose in accordance with Clause 2.1.2 of this specification and PVC cables and earth wire of the required size.

An isolator shall protect all fixed apparatus and where necessary a starter fitted with a no-volt coil and overload protection adjacent to such apparatus.

Power points for connection of fixed apparatus to be installed by others, shall terminate in an approved type, wall mounted switch unless otherwise specified.

The minimum conductor sizes for all power points shall be 4mm² unless otherwise specified.

20.5 Underground Service Connection

This clause refers to underground service connections not provided by the Supply Authority.

The service cable and earth wire to be connected at the supply point in accordance with Clause 1.21.8 of this specification, and unless otherwise specified, shall be laid 600mm below ground level throughout and otherwise fully in accordance with Clause 1.21 and all applicable sub-clauses thereof. Cable entries to meter boxes shall be in accordance with Clause 1.19 and other entries shall be by pipe or duct as directed.

20.6 Connections to Outbuildings

Connections to outbuildings shall be made by means of underground cable only, laid in accordance with Clause 1.21 and all applicable sub-clauses.

Where the cable is run from the roof space of the main building, it shall be enclosed in suitably sized galvanized pipe built into the wall or run surface as directed. Surface run pipes shall be securely saddled at 1800mm centers. Where the cable connects to the conduit in the roof space, a suitable joint box shall be provided or alternatively the cable may be taken through the roof space with fixings at regular intervals, and down into the main board. At the outbuildings, the cable shall be enclosed in a suitably sized galvanized sleeve pipe built into the wall or run surface and terminated in the distribution board tray.

20.7 Connection and Mounting of Cable Fed Street/Site Lighting

Street/site lights shall in all cases, except where otherwise specified, be fed by underground cable. Unless otherwise directed, a suitable terminal board shall be provided in the base of the lightning pole for the connection of the incoming and outgoing cables, the feeds from the terminal board to the fitting shall be as specified.

“Surfix” cable and compression glands shall be installed between terminal board and cross arm/bracket-mounted luminaires. The terminal board shall also accommodate a miniature circuit breaker in the phase connection to the fitting. Poles intended for mounting directly in ground are to be provided with a 300mm x 300mm base plate.

21 UNDERGROUND CABLES

1000 Volt PVC SWA and 1100 Volt PILCA cable and accessories shall be in accordance with SANS 1507.

The storage, transportation, handling and laying of underground cables shall be according to the manufacturers requirements and the Contractor shall have adequate and suitable equipment and labour to ensure that no damage is done to cables during such operation. All cable pipes and ducts entering buildings are to be sealed against the ingress of vermin, water, etc.

21.1 Trenching

Cables, unless otherwise specifically directed, shall be laid at a depth of 600mm below ground level. Trenches shall not be less than 300mm wide for one to three cables, and the width shall be increased where more than three cables are laid together so that the cables may be placed at least 75mm apart throughout the run.

The Contractor shall take all necessary precautions to prevent trenching work being in any way a hazard to the public and to safeguard all structures, roads, sewer works, or other property from risk of subsidence and damage.

21.2 Cable Joints

Joints in underground cable runs will not be permitted unless unavoidable and at the discretion of the Employer. Where cable joints are unavoidable, the cable jointer is to work efficiently and cleanly and so that each end of the cables to be joined may have a minimum of 900mm of slack disposed in a loop without stress. Back filling under joints must be firmly tamped to prevent any subsequent settling.

21.3 Bedding

In trenches made in intermediate, hard rock, or boulder material, the cables shall be laid on a 75mm thick bed of earth and be covered with a 150mm layer of earth before the trench is filled in. The Contractor to supply all earth required for trench filling.

21.4 Laying

Cable shall be removed from the cable drum in such a way that no twisting, tension or mechanical damaged is caused, and must be adequately supported at short intervals during the whole operation. Particular care must be exercised where it is necessary to draw cables through pipes and ducts, to avoid abrasions, elongation or distortion of any kind. The ends of such pipes and ducts shall be sealed to approval after the drawing in of the cables.

21.5 Back Filling

Back filling after bedding (see Clause 1.21.3) is to be carried out without a proper grading of the material to ensure settling without voids, and the material is to be

tamped down after the addition of every 150mm. The surface is to be made good as required.

Back filling of cable trenches shall not commence until after the cable trenches and laid cable(s) have been inspected by the Employer. Where a Contractor fails to observe this requirement, he may, at the discretion of the Employer, be required to re-open such cables trenches for inspection at his own expense.

21.6 Protection of Cables

Where so directed by the Employer, concrete or other warning covers shall be placed over cables above the top-bedding layer. Cable pipes when directed are to be installed at road and other crossings.

21.7 Marking of Cables

Cable marking tape is to be supplied by the Contractor and is to be laid 150mm below ground over a cable run and as may be directed by the Employer to give early indication of underground cable runs.

21.8 Joints and Termination of Cables

Joints in underground cables and terminations shall be made by means of “Scotch-Cast” or other approved epoxy-resin pressure type joining kits. Low-tension PVC cables are to be made off with sealing and materials specially designed for this purpose, which must be an approved make.

Where cables terminate in a switchboard, the glands or end boxes shall be bolted to a gland plate of the switchboard.

Cable leads of paper-insulated cables shall be taped with two layers of “Empire” tape and one layer of the correct phase coloured tape.

21.9 Sealing of Paper Insulated Cable Ends

Where cables are cut and not immediately made off, the ends must be sealed without delay. If cables are cut and the ends not immediately made off or sealed, the cable may be rejected and the Contractor will be required to replace it at his own expense.

21.10 Opening Up of Existing Cables

Where it is necessary to expose existing buried cables for any purpose, or to excavate in the vicinity of existing buried cables, pipes etc, every care is to be exercised and only labourers experienced in such work, and duly warned by the Contractor, shall be employed thereon.

21.11 Definitions for Classifying of Excavation

- a) Soft Excavation – shall be excavation in material that can be efficiently removed

by a back acting excavator of flywheel power approximately 0,10kW per millimetre of tinned-bucket width, without the assistance of pneumatic tools such as paving breakers or that can be efficiently loaded, without prior ripping or stockpiling, by a rubber tyred front-end loader approximately 15T mass and a flywheel power of approximately 100kW.

- b) Intermediate Excavation – shall be excavation in material that requires a back-acting excavator of flywheel power exceeding 0,10kW per millimetre of tinned bucket width and the assistance of pneumatic tools prior to removal by equipment equivalent to that specified in a) above.
- c) Hard Rock Excavation – shall be excavation in material that cannot be efficiently removed without blasting or without wedging and splitting prior to removal.
- d) Class A Boulder Excavation – shall be excavation in materials containing more than 40% by volume of boulders of sizes between 0,03 cubic meter and 20 cubic meters in matrix of softer material or smaller boulders.

Note: 1) Excavation of solid boulders or lumps of size exceeding 20 cubic meters will be classified as hard rock excavation.

2) Excavation of fissured or fractured rock will not be classed as boulder excavation, but as hard rock intermediate excavation according to the nature of the material.

- e) Class B Boulder Excavation – shall be excavation of boulders only in a material containing 40% or less by volume of boulders of size between 0,03 cubic meter and 20 cubic meters in a matrix of softer material or smaller boulders.

Note: Those boulders that required individual drilling and blasting in order to be loaded by a back-acting excavator as specified in a) above, or by a track type front-end loader, will each be separately classed as Class B Boulder Excavation.

22 EARTHING

22.1 Main Earthing

The type of main earthing shall be as required by the Supply Authority, if other than the Administration and in any case as directed by the Engineer who may require additional earthing to meet test standards.

Where required, an earth mat is to be provided, the minimum size, unless otherwise specified, being constructed from copper straps (950 x 25 x 3mm) at 230mm centres and braced at all intersections. Alternatively, or additionally, earth rods or trench earths may be required, as the Director - Facilities Management, Department of Health may direct, and installed according to his instructions.

All earth electrodes and connections thereto must be approved “in-situ” by the Engineer before back filling.

The electrical installation shall not be earthed by means of the lightning conductor earth electrode, if such is included in the installation, but must be bonded thereto.

An earth mat shall be installed only if specifically called for in the detailed specification.

22.2 Earthing of Installations

The installation shall be effectively earthed in accordance with the relevant sections of the SANS 10142-1 Clause 6.12 and the requirements of the Supply Authority.

All hot and cold water and waste pipes are to be effectively bonded by means of 12 x 1,5mm solid copper tape (perforated tape or wire will not be permitted), clamped by means of brass bolts and nuts. Bonding tapes exceeding 75mm in length must be fixed to the wall by means of No. 6 x 20mm brass screws and plastic plugs not exceeding 150mm centres. Main earth copper tapes where installed less than 2,4m from ground level, must be run in 20mm diameter conduit securely saddled to the wall.

Gutters and down pipes are to be bonded by means of 6mm round headed brass bolts, with nuts and washers. Self-tapping screws are not permitted.

Connections from the earth bar or terminal on the main board must be made to a visible cold water main, the incoming service conductor, if any, and the earth mat or plate (where such is required) by means of either 12 x 1,5mm solid copper tape or bare 25mm² copper wire, or such larger conductor as the Employer may direct. From each distribution board separate earth conductors are to be taken to the main earth bar or terminal on the main board. Each conductor shall consist of stranded copper conductors drawn into the conduit together with the distribution board feeders. The sizes of the earth conductors are to be in accordance with the requirements of the Code of Practice 0142-1 or as specified.

Earthing clips shall be made of not less than 0,90mm thick copper strips, not less than 12mm wide. They are to be complete with 25 x 7,7mm brass bolts, washers and nuts and must be constructed so that the clips will fit firmly to the conduit without any additional packing. Adjustable earth clips are not permitted.

23 NORMAL AND EMERGENCY ELECTRICAL SERVICES

Normal and emergency (essential) electrical power shall be provided via separate distribution boards.

The capacity of emergency (standby) power for hospitals is shown hereunder in table form.

One hundred percent (100%) emergency power shall be provided for the following:

Operating Theatres.	I.C.U's and E.C.U's.
X-ray department inclusive of dark room except for three (3) phase x-ray units.	Lifts.
Casualty Department.	Boilers.
Labour Ward (Delivery rooms only).	Medical gas and vacuum pumps.
Communication services.	Operating theatre ventilation fans and air handling units.
Dedicated domestic services (Sewage and water pumps etc.	All plant rooms (Lighting and switch socket outlets -SSO's).
X-ray viewers.	All cold rooms.
Security lighting.	Fuel pump for generators.

Night laboratory lighting.	
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Partial emergency power shall be provided for the following:

Lighting, generally 50% but in wards, all bedhead ducting including SSO's	Approximately 50% of SSO's.
Ventilation (Not chillers)	Acute wards.

Uninterrupted power supply (UPS) power shall be provided for the following:

Everything in theatres including earth monitoring.	ICU and CCU bedhead ducting including earth monitoring.
All communication services.	At least one light fitting in main electrical plant rooms. (Generator room, main switch room etc.)

If kitchen primary energy source is electricity, certain appliances shall be fed off the emergency power source. These will be determined at the time for each institution.

If electric heaters are fitted in doctors and nursing quarters, they must be fed via isolators off the normal power source.

If air conditioners are fitted in institutions, they must be fed via isolators off the normal power source.

24 **EXISTING BUILDINGS**

24.1 **Occupied Buildings**

Where work is to be carried out in occupied buildings, the Contractor must arrange to carry out the installation with as little interruption to services and discomfort to the occupants as possible.

24.2 **Temporary Connections**

Temporary connections shall be provided where necessary for continuity of services, and as directed by the Engineer. The Contractor must ensure that such connections are both electrically safe and free from physical hazard.

24.3 **Old Materials**

Unless otherwise specified, all existing materials removed by the contractor shall remain the property of the Client, and shall be delivered to his authorised representative who shall issue a detailed receipt for such items.

24.4 **Making Good**

Any damage which may be done to the plasterwork, floors, ceilings, wood and paint work, furniture and other equipment in the building etc, during the process of the

electrical installation shall be repaired and made good by the Contractor to the satisfaction of the Engineer.

25 COMPLETION

25.1 Balancing of Load

The Contractor is required to balance the load as equally as possible over multi-phase supplies.

25.2 Tests

The installation shall be tested by the Contractor as the service progresses, or as required by the Engineer and upon completion, for earth continuity and insulation. The final test before the taking over of the installation shall be made in the presence of the Engineer.

The mandatory “Certificate of Compliance” shall be issued by the Contractor to the Engineer with a copy to the Supply Authority, prior to first delivery being taken.

25.3 Labelling

All circuits and apparatus on switchboards shall be suitably and correctly labelled by means of engraved plastic labels (white lettering on black), lettering shall be 3mm in height, which are to be either bolted or screwed to the equipment panel, or fitted in channelling provided below the switchgear.

Sub-circuits are to be numbered and a legend card detailing the circuits is to be framed and fitted to the door of the distribution board.

All other equipment is to be individually labelled to indicate the function in accordance with the SANS 10142-1 Table 4.3.

All switchboards are to be fitted with a label on which the designation of the board is clearly indicated.

A separate engraved label depicting the origin and/or destination and cable/conductor size shall be fixed below the main switch.

All cables shall be fitted with a separate engraved label depicting the size of the cable. The label shall be fitted to the cable using suitable cable ties and shall be located directly below the shroud of the cable gland.

25.4 Finishes

Covers for all boxes, expansion boxes etc, shall be finished to match the paint work of the ceiling or wall surface or as specified.

25.5 Site Drawing

For all completed new works or where specifically called for in the Tender Document, the Contractor shall, on completion of the works, submit to the Engineer, in an electronic format and hard copy a marked up site plan indicating the exact underground cable reticulation, siting and identification of all main distribution boards and sub-distribution board

**HEUWELLAND PRIMARY SCHOOL
ELECTRICAL INSTALLATION
FOR
DEPARTMENT OF EDUCATION
IN THE
KING CETSHWAYO DISTRICT
FOR THE
DEVELOPMENT BANK OF SOUTH AFRICA
PROVINCE OF KWAZULU-NATAL**

SECTION 2: PROJECT SPECIFICATION

SECTION TWO

PROJECT SPECIFICATION FOR THE

ELECTRICAL INSTALLATIONS

SECTION TWO

PROJECT SPECIFICATION FOR ELECTRICAL INSTALLATIONS

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1. **GENERAL**

This Project Specification must be read together with the General Electrical Specification for electrical works. In case of conflict, the project specification shall take preference.

This Project Specification together with the drawings and bills of quantities describe the scope of works to be executed in terms of this documentation and takes precedence over the General Electrical Specification.

2. **PROPRIETARY MATERIALS, SYSTEMS, ETC.**

Any reference in these Bill of Quantities to trade or brand names (and catalogue numbers, etc.,) shall be deemed to be followed by the words “or other approved”. Refer to Clause 15 on page GA3 for definition of “approved” and for procedure to be followed.

The Tenderer’s special attention is drawn to the fact that in connection with the aforementioned where ever any wording with meanings equating with similar to, equal to, equivalent to, etc, are used in combination with a trade or brand names (and catalogue numbers, etc.,) they shall be deemed to be omitted and entirely replaced by the trade or brand names (or catalogue numbers, etc.,) followed by the words “OR OTHER APPROVED”. This will take precedence over any contradictory clause or note appearing anywhere on these Bills of Quantities.

3. **REGULATIONS, FACTORIES ACT AND BY-LAWS**

- 3.1 The latest issue of the SANS 10142 “Code of Practice for the Wiring of Premises”, hereafter called the “Wiring Code”.
- 3.2 The Machinery and Occupational Safety Act No. 85 of 1993.
- 3.3 The Municipal By-Laws and any special requirements of the local Supply Authorities.
- 3.4 The local Fire Office Regulations.

4. **NOTICES AND FEES**

The Contractor shall give all notices required by and pay all necessary fees, including any inspection fees, which may be due to the local Supply Authority. The fee charged by the Supply Authority for connection of the installation to the supply mains, will be arranged and paid by the Contractor.

5. **QUALITY OF MATERIALS**

Only materials of first class quality shall be used and all materials shall be subject to the approval of the Engineer.

Wherever applicable, material is to comply with the relevant South African Bureau of Standards Specifications, or to British Standard Specifications, where no SANS Specifications exist.

Materials, wherever possible, must be of South African manufacture.

6. **SITE**

The Tenderers must, before submitting their tenders, acquaint themselves with the local conditions, accessibility of the sites, soil conditions, availability of labour and labour conditions, transport, off-loading, store and custody conditions for materials and equipment necessary for the completion of the total contract. No claim based on ignorance in this regard shall be considered.

7.

SCOPE OF CONTRACT

The sub-contract comprises the supply, delivery, off-loading, storage, installation, commissioning, testing, handing over and maintenance for the period stated in the tender document and applicable drawings for the Heuwelland Primary School.

The School comprises of Sixteen (16) blocks:

Block A:	Existing Administration Building
Block B:	Existing Assembly Hall Building
Block C:	New 4 Classroom and 2 Ablution Building
Block D:	New 6 Classroom and 2 Ablution Building
Block E:	New Media Centre Building
Block F:	New Multipurpose Classroom Building
Block G:	New Multipurpose Classroom Building
Block H:	New Computer Room Building
Block J:	New 4 Classroom and 2 Ablution Building
Block K:	New 4 Classroom, 7 Storeroom and 2 Ablution Building
Block L:	New 2 Classroom Building
Block M:	New 2 Classroom Building
Block N:	New 2 Grade R Classroom and Ablution Building.
Block P:	New 2 Grade R Classroom and Ablution Building.
Block Q	New Guard House Building
Block R	New Kiosk (Tuckshop) Building

This installation consists of the following:

- Upgrade existing point of supply.
- Supply and installation of distribution kiosk.
- Supply and installation of low voltage cable reticulation.
- Supply and installation of low voltage distribution boards.
- Supply and installation of complete lighting layout.
- Supply and installation of complete small power layout.
- Supply and installation of Data, Telephone and PABX
- Supply and installation of Alarm and CCTV System
- Fire Detection and Public Address System
- Supply and installation of Lightning Protection and Earthing System.

The tenderer's attention is drawn to the fact that he must include in his tender price for all equipment, material, labour and additional costs, in order to carry out the installation in its entirety and to complete it in accordance with the Specification and applicable drawings and to the satisfaction of the Engineer.

8.

ELECTRICITY SUPPLY

The supply authority to the area is UMhlathuze Municipality. A provisional sum has been allowed in the bill of quantities for a new point of supply to the school. The Contractor is required to liaise and arrange in good time with the Municipality for the installation of the new bulk power supply. A new 50kVA Three Phase Transformer Supply is required.

9.

"AS BUILT" DRAWINGS

The Contractor is to prepare the "as-built" paper prints in strict accordance with this specification. These drawings are to be kept in the site office. The "AS BUILT" drawings shall be handed over to the Engineer at First Delivery. Retention money normally due before

commencement of the maintenance period will not be released until “as-built” drawings have been prepared to the satisfaction of the Engineer.

10. **SUPERVISION**

Work must under all circumstances be supervised by a qualified and experienced representative of the Contractor who must be the holder of an electrical installation certificate. The representative must be authorised by the Contractor and must be able to receive instructions on behalf of the Contractor.

11. **CERTIFICATE OF COMPLIANCE BY AN ACCREDITED PERSON**

On completion of the electrical installation, the Contractor shall complete the Certificate of Compliance for the electrical installation in the form of Annexure 1 as described in the Occupational Health and Safety Act No. 85 of 1993, as amended, and obtainable from the Electrical Contracting Board of South Africa. This form must be handed to the Engineer at first delivery.

12. **ELECTRICAL EQUIPMENT**

All fittings, material and equipment and component parts thereof are to be in accordance with the Specification and must have the approval of the Engineer. In addition all equipment shall be designed, manufactured and tested in accordance with the relevant South African Bureau of Standards Specification, or otherwise, the relevant British Standard Specification.

All material and equipment must be suitable for the supply voltage 400/230V and the necessary precautions shall be taken against corrosion, i.e. exposed metal shall be anti-rust treated to approval and all metalwork to be galvanised or painted.

13. **CABLES**

13.1 **General**

Supply, install and terminate all the low voltage cables specified in this document. See schedule of cables below in paragraph 13.2.

Bare hard drawn copper earth continuity conductors are only to run with the underground cables if cables used are not ECC cables. The earth conductors must be bound to the cables at intervals not exceeding 1 meter.

Conductor isolation, which is colour coded by a line only, will not be accepted. The total isolation must have the phase colour.

Cable Schedule

The following cables must be supplied and installed by the Contractor:

From	To	Cable Size	Bare Earth Conductor Size
Municipality Meter	LV Kiosk	50mm ² x 4 core	25mm ²
LV Kiosk	DB-A	25mm ² x 4 core	16mm ²
DB-R	DB-B	10mm ² x 3 core	6mm ²
LV Kiosk	DB-C1	16mm ² x 3 core	10mm ²
DB-C1	DB-C2	10mm ² x 3 core	6mm ²
LV Kiosk	DB-D1	16mm ² x 3 core	10mm ²
DB-D1	DB-D2	10mm ² x 3 core	6mm ²
DB-F	DB-E	10mm ² x 3 core	6mm ²
LV Kiosk	DB-F	16mm ² x 3 core	10mm ²
LV Kiosk	DB-G	10mm ² x 4 core	6mm ²
DB-G	DB-H	10mm ² x 4 core	6mm ²
DB-M	DB-J1	10mm ² x 3 core	6mm ²
DB-J1	DB-J2	10mm ² x 3 core	6mm ²
DB-L	DB-K1	10mm ² x 3 core	6mm ²
DB-K1	DB-K2	10mm ² x 3 core	6mm ²
LV Kiosk	DB-L	16mm ² x 3 core	10mm ²
LV Kiosk	DB-M	16mm ² x 3 core	10mm ²
DB-P	DB-N	10mm ² x 3 core	6mm ²
LV Kiosk	DB-P	10mm ² x 3 core	6mm ²
DB-D1	DB-Q	6mm ² x 3 core	4mm ²
LV Kiosk	DB-S	10mm ² x 4 core	6mm ²

Installation**(a) Testing**

All low voltage cables must be tested on site, in the presence of the Engineer. All test results must be submitted to the Engineer.

On each completed section of the laid cable, the insulation resistance shall be tested to approval with an approved “Megger” type instrument of not less than 500V for low voltage cables.

(b) Marking Tape

Yellow PVC marking tape, 150mm wide, must be supplied and installed above all cables as indicated on the cable reticulation drawing. The wording “Electric Cable Below – Caution” and “Elektrische Kabel Hieronder – Gevaar” must be provided on the marking tape.

(c) Cable Lengths

Tenderers must base their tender price on the preliminary lengths specified in the Bills of Quantities. After installation, the exact lengths shall be determined on site. Adjustments to the contract price shall then be calculated tariffs in the Bills of Quantities.

It shall be the responsibility of the Electrical Contractor to establish the correct lengths of cable on site, before placing an order. The Contractor shall not be

reimbursed for any surplus cable.

(d) **Cable Laying**

Cables must be removed from the drums in such a manner that the cable is not subjected to mechanical damage, twisting or tension exceeding that stipulated by the cable manufacturer.

The laying of cables shall not commence until the trenches have been inspected and approved. The cables must be adequately supported at intervals during the whole operation. Particular care must be exercised where it is necessary to draw cables through pipes and ducts to avoid abrasion, elongation or distortion of any kind. The ends of such pipes and ducts shall be sealed to approval after drawing in of the cables.

13.4

Cable Sleeves

Sleeves must be supplied and installed as indicated on the drawings and in accordance with SANS 1200 LC.

110mm diameter cable sleeves are to be installed from the main distribution board position underground and routed to a 600 x 600 x 600mm deep manhole. There shall be 75mm diameter cable sleeves exiting the manhole laid underground and routed to the distribution boards as indicated on the drawings. The cable sleeves will be used to accommodate the electrical cables and the Data cabling. The cable sleeves shall enter into the distribution boards.

32mm diameter cable sleeves are to be used for supply power, telephone and Data cables.

90° Bends will not be permitted; this shall be overcome by the use of two 45° slow bends. The drawings show the conduits, sleeves, boxes, etc. that are required for the installation. The final details are not available at tender stage and these details will be provided at a later stage. Provisional quantities covering this installation have been included in the Bills of Quantities. Galvanised steel draw wires shall be installed in all these conduits and sleeves.

The Contractor should note that he remains responsible to ensure that all conduits and sleeves are open and accessible. Where these are blocked, he shall be responsible to repair them.

In all cases conduits for telephone and Data services shall be linked back to the main telephone and Data wire mesh baskets.

13.5

Cable Markers

Cable markers must be provided on all cable runs at 50m intervals on straight runs and at all bends. The position of cable markers must be confirmed on site.

The cable markers must protrude 25mm above ground level.

13.6

Joints

Joints in cable runs shall not be allowed unless specified or authorised by the Engineer.

Where cable joints are to be made, a joint hole must be excavated of sufficient size to enable the cable joiner to work efficiently and unimpeded.

Each cable end must be left in a loop of 0,9m to prevent any tension on the joint.

During backfilling the section supporting the joint must be compacted to the extent that no movement will take place after the trenches have been backfilled.

All joints in underground cables and terminations shall be made either by means of compound filled boxes according to the best established practice by competent cable joiners using first class materials, or by means of approved epoxy-resin pressure type jointing kits, such as “Scotch cast”. Epoxy-resin joints must be made entirely in accordance with the manufacturer’s instructions and with materials stipulated in such instructions.

Where cables are cut and not immediately made off, the ends are to be sealed without delay.

13.7 **Cable Trenches**

(a) **General**

Tenderers must base their tariffs for cable trenches in soil, soft rock and hard rock on the quantities given in the Bills of Quantities. The actual quantities shall be determined on site. Adjustments to the contract price shall be calculated using the tariffs in the Bills of Quantities, after completion of the installation.

The provision of trenches for the lying of cables and the installation of cable sleeves forms part of this contract. All cables and sleeves shall be laid at a depth of 600mm except that sleeves below the building may be laid at a lesser depth provided that the Engineer is satisfied that no damage to the sleeves can occur.

The bottom of the trenches shall be of smooth contour and shall have no sharp dips or rises, which may cause tensile forces in the cable during backfilling.

Prior to cable lying, the trench shall be inspected thoroughly and all objects likely to cause damage to the cables, either during or after lying, shall be removed.

“Soil” shall mean hand pickable soil and includes loose gravel, clay, backfilled soil, loose or soft shale, loose oukclip and boulders less than 75mm diameter.

“Intermediate material” shall mean rock which is hand pickable including hard shale, compact oukclip and boulders exceeding 75mm in diameter to 0,03 cubic metres volume; and

“Hard rock” shall mean granite, quartz sandstone, slate and stone of similar hardness as well as rocks exceeding 0,03 cubic meter volume.

No guarantee can be given that explosives will not be necessary for excavations. However, should explosives be necessary and the Contractor receives permission to use explosives, the Contractor shall remain responsible for all work done with the explosives and shall comply with all conditions, regulations, requirements, etc. imposed by the governing bodies.

Mechanical excavators may be used for trenching operations provided that they are not used in close proximity to other plant, services or other installations likely

to be damaged by the use of such machinery. The use of mechanical excavators shall be subject to the approval of the Engineer.

Should excavations be done in close proximity of existing services, extreme care must be taken. Only labourers with experience of these conditions may be utilised.

The Contractor shall be responsible to take the necessary precautions where excavations may be dangerous (refer to the Machinery and Occupational Safety Act 1983, Reg. D16). The Contractor must ensure that all buildings, sewers, etc. are protected against caging.

The cable trenches shall be excavated as indicated on the cable reticulation drawing.

Payment will be made on a cubic excavation rate based on the basis of the given maximum dimensions or the actual dimensions, whichever is the lesser. The only exception shall be in cases of additional excavations caused by obstructions such as water pipes, drains, large rocks, etc. in which case the length of the additional excavation must be agreed upon on site by the Engineer.

(b) Dimension of Trenches

Cable trenches for one or two cables or sleeves shall not be less than 300mm wide and need not be more than 450mm wide. This dimension shall be valid for the total trench depth.

Where trenches change direction or where cable slack is to be accommodated, the contractor shall ensure that the requirements of the relevant SANS Specification regarding the bending radii of cables are met when determining trench widths.

Trench depths shall be determined in accordance with cable laying depths and bedding thickness.

(c) Trenches: Bedding

The bottom of the trench shall be filled across the full width with a 75mm layer of suitable soil sifted through a 6mm mesh and levelled off.

Only sandy clay or loam soil with a satisfactory thermal resistivity (not exceeding 1,5 C m/W) may be used for this purpose. Sea or river sand, ash, chalk, peat, clinker or clayey soil shall not be used. The use of crusher sand is acceptable.

Where no suitable soil is available on site, the Contractor shall import fill from elsewhere and make all the necessary arrangements to do so. The cost of importing soil for bedding purposes shall be included in the unit rates for excavations.

After cable laying a further layer of bedding shall be provided to extend to 75mm above the cables.

(d) Backfilling

The Contractor shall not commence with the backfilling of trenches without prior notification to the Engineer so that the cable installation may be checked. Should the Contractor fail to give a timeous notification, the trenches shall be re-opened

at the Contractor's cost. Such an inspection will not be unreasonably delayed.

Backfilling shall be undertaken with soil suitable to ensure settling without voids. The maximum allowable diameter of stones present in the backfill materials is 75mm.

The Contractor shall have allowed in his tender for the importation of suitable backfill material if required and such costs shall be priced separately.

The backfill shall be compacted in layers of 150mm and sufficient allowances shall be made for final settlement for the first layer of 150mm, sifted soil of which 75mm must be below and 75mm must be above the cable, must be used. The Contractor shall maintain the refilled trench at his expense for the duration of the contract. Surplus material shall be removed from site and suitably disposed of. On completion of the contract the surface shall be made good to match the surrounding area.

In the case of roadways or paved areas the excavations shall be consolidated to the original density of the surrounding material and the surface finish reinstated.

(e) **Trenches: Measurement**

Trench excavations shall be measured and paid for as per the unit rate included by Tenderers for excavations. In all cases the cost of excavations shall include separately the total cost of excavating, bedding, backfilling and making good and keeping excavations free from water (except subterranean water) and risk of collapsed to trench sides.

Definitions for the different type of excavations are as follows:

Refer to SP 3 Preambles to All Trades.

14.

DISTRIBUTION BOARDS

All boards shall be of the totally enclosed metal clad, metal frame type with flush mounted instruments and switch gear complete with all cable connections, external wiring, busbars, etc. which might be required. Surge arrestors must be installed in each of the electrical distribution boards.

The board shall receive an undercoat and two final coats of "Biscuit" colour B64 or "Light Stone" colour C37 of SANS 1091.

The boards shall be of type as specified, with hinged doors, complete with press lock catches. All boards shall be installed in positions as indicated on the schedules.

All switchgear shall be labelled with engraved ivorene labels to indicate circuits, lights or plugs. The board shall be marked on the outside as follows:

- a) Number of the distribution board,
- b) Source from which this particular board is fed,
- c) The cable size e.g.
 - i) Distribution boards : DB-A
 - ii) Fed from LV Kiosk
 - iii) Cable sizes 3 core 16mm² cable plus 10 mm² earth wire.

In general the surface distribution boards shall consist of a sheet bonding tray fitted with a removable architrave and a door unit as detailed below.

a) Bonding Tray

The bonding tray shall be of pressed and welded construction using mild steel sheet. The outside lip shall be flanged out from and knock-outs shall be provided at both top and bottom of the tray. These knock-outs shall mainly be 20mm dia. But at least two 25 mm dia. Knock-outs shall be provided at each end. The total number of 20mm knock-outs on each end shall not be less than the number of circuit breakers (including spares carried on the board).

The back of the tray shall be fitted with diamond mesh spot welded to the tray to facilitate plastering.

Frame and Chassis

An architrave frame formed from mild steel sheet with bevelled edges, which shall accommodate panel, chassis and door(s). Frame to be fixed to tray in a suitable manner as to allow for adjustment for depth out of plumb, and for wall finish inequalities, and shall overlap the tray by not less than 25 mm all round. Frames shall house the following :

- (i) Chassis for mounting of equipment fixed to the architrave frame shall be of rigid construction provided with the necessary means for fixing of circuit breakers, isolators, etc.
- (ii) Panels of flat mild steel with machine punched slots to allow for flush mounting of circuit breakers and isolators.

Semi-flush boards must be provided within architrave extension frames.

c) Doors

Doors of smooth flat finish steel sheet suitably braced to ensure stiffness shall be recessed flush in the architrave. Catches shall be flush mounted. Single doors shall not exceed a width of 610 mm.

All steelwork to be pacified, smooth finished and covered with hard baked enamel paint. Final finish of boards shall be beige or as indicated by the Engineer.

d) Busbars

Copper busbars, provided for each phase and neutral shall be mounted on isolators of fixed directly to the terminals of single pole miniature circuit breakers only. All busbars shall be tinned. Boards shall be suitably sized to accommodate without undue cramping, the equipment specified.

A substantial brass earth bar, solidly bonded to the metal work of the board, is to be provided with connectors for the incoming earth conductors and the earth wires of outgoing circuits.

- e) Two spare 20 mm and two spare 25 mm conduits respectively must be installed from the distribution boards into roof spaces.

Drawings for Comment

A set of three prints of the shop drawings for the switchboards shall be submitted to the Engineer for comment before the boards are manufactured. The following information shall be presented.

- 1) A complete wiring diagram of the equipment on the boards.
- 2) A complete layout of the arrangement of the switchboards, indicating all equipment dimensions and the construction of the boards.
- 3) The make, catalogue number and capacity of all equipment such as isolators, circuit-breakers, fuses, contractors, etc.

14.1 **Labelling**

Clearly legible labels, in English, are to be mounted below each circuit breaker and light switches to show the type of circuit each supplies using plastic labels fixed to the boards and not dymo taped labels. The name of the distribution board, e.g. DB-A, shall be fixed on to the door.

In addition a label, e.g. (Fed from Main Kiosk), of lettering one size smaller than the main label shall be fixed below the main label.

14.2 **Installation**

The distribution boards must be placed in the position shown on the drawings and must be installed level with the top most circuit breaker 2,0 m above the finished floor level.

15. **MOUNTING OF EQUIPMENT**

The mounting of equipment shall comply with SANS 1180, where applicable. Equipment to be mounted on the chassis shall be mounted by bolts, washers and nuts or by bolts screwed into tapped holes in the chassis plate.

In the latter case, the minimum thickness of the chassis plate shall be 2,5mm. The latter method shall not be used where boards will be subject to vibration or mechanical shocks. Self-tapping screws will not be accepted.

16. **DISTRIBUTION BOARD SCHEDULE**

16.1 MAIN LV KIOSK

The Distribution Main LV Kiosk is to be partially type tested assembly.

Name:	Main LV Kiosk
Mounting:	Surface Floor Mounted
Doors:	Yes
Meters:	Metering Cubicle for Municipality Meter
Colour:	Sandstone, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	200A
Fault Level:	10kA
Voltage:	415/240V
Surge Arrestors:	Yes
Spare space:	30%
1 x 200A TP Isolator 15kA	Main Switch
1 x 63A TP MCB 10kA	Feed to DB A (Office Block)
1 x 63A SP MCB 10kA	Feed to DB C1 (Classroom Block)
1 x 63A SP MCB 10kA	Feed to DB D1 (Classroom Block)
1 x 80A SP MCB 10kA	Feed to DB F (Multipurpose Classroom Block)
1 x 30A TP MCB 10kA	Feed to DB-G (Multipurpose Classroom Block)
1 x 63A SP MCB 10kA	Feed to DB-L (Classroom Block)
1 x 63A SP MCB 10kA	Feed to DB-M (Classroom Block)
1 x 30A SP MCB 10kA	Feed to DB-P (Classroom Block)
1 x 30A TP MCB 10kA	Feed to DB-S (Pump House Block)
1 x 20A SP MCB 10kA	Feed to Floodlights (Control Panel)

The above section is fed from a Municipality Mini substation with a 50mm² 4 Core PVC/SWA ECC/PVC Copper Cable.

16.2 Distribution Board –DB-A.

The Distribution Board is to be partially type tested assembly.

Name:	DB-A
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	100A
Fault Level:	6kA
Voltage:	415/240V
Surge Arrestors:	Yes
Spare space:	30%
1 x 100A TP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
11 x 10A SP MCB 6kA	Light Circuits L2 to L12
3 x 63A SP MCB 6kA	Feed to Earth Leakage Units
3 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
10 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P10
5 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1 to DP5
2 x 6A SP MCB 6kA	Extract Air Fan Circuits P11 to P12
1 x 20A SP MCB 6kA	Hydroboil Circuit P14
2 x 6A SP MCB 6kA	Supply Air Fan Circuits P15 to P16
12 x 20A SP MCB 6kA	Feed to A/C Circuits P P17 to P29

The above section is fed from LV Kiosk with a 25mm² 4 Core PVC/SWA ECC/PVC Copper Cable

16.3 Distribution Board –DB-B.

The Distribution Board is to be partially type tested assembly.

Name:	DB-B
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	60A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 45A SP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
2 x 10A SP MCB 6kA	Light Circuits L2 to L3
1 x 63A SP MCB 6kA	Feed to Earth Leakage Units
1 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
2 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P2
1 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1
2 x 6A SP MCB 6kA	Ceiling Sweep Fan Circuits P11 to P12

The above section is fed from DB-R with a 10mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.4 **Distribution Board –DB-C1**

The Distribution Board is to be partially type tested assembly.

Name:	DB-C1
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	80A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 63A SP Isolator 6kA	Main Switch
1 x 30A SP MCB 6kA	Feed to DB-C2
1 x 30A SP MCB 6kA	Feed to DB-R
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
3 x 10A SP MCB 6kA	Light Circuits L2 to L4
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
6 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P6
1 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1
1 x 6A SP MCB 6kA	Extract Air Fan Circuits P7

The above section is fed from LV Kiosk with a 16mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.5 Distribution Board –DB-C2

The Distribution Board is to be partially type tested assembly.

Name:	DB-C2
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	60A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 45A SP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
3 x 10A SP MCB 6kA	Light Circuits L2 to L4
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
6 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P6
1 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1
1 x 6A SP MCB 6kA	Extract Air Fan Circuits P3

The above section is fed from DB-C1 with a 10mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.6 Distribution Board –DB-D1

The Distribution Board is to be partially type tested assembly.

Name:	DB-D1
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	80A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 63A SP Isolator 6kA	Main Switch
1 x 30A SP MCB 6kA	Feed to DB-D2
1 x 25A SP MCB 6kA	Feed to DB-Q
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
3 x 10A SP MCB 6kA	Light Circuits L2 to L4
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
6 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P6
1 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1
1 x 6A SP MCB 6kA	Extract Air Fan Circuits P3

The above section is fed from LV Kiosk with a 16mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.7 Distribution Board –DB-D2

The Distribution Board is to be partially type tested assembly.

Name:	DB-D2
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	80A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 63A SP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
3 x 10A SP MCB 6kA	Light Circuits L2 to L4
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
6 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P6
1 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1
1 x 6A SP MCB 6kA	Extract Air Fan Circuits P3

The above section is fed from DB-D1 with a 10mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.8 Distribution Board –DB-E

The Distribution Board is to be partially type tested assembly.

Name:	DB-E
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	80A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 63A SP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
3 x 10A SP MCB 6kA	Light Circuits L2 to L4
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
4 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P4
1 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1
1 x 6A SP MCB 6kA	Supply Air Fan Circuits P5
2 x 20A SP MCB kA	Feed to A/C Circuits P6 to P7

The above section is fed from DB-F with a 10mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.9 Distribution Board –DB-F

The Distribution Board is to be partially type tested assembly.

Name:	DB-F
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	100A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 80A SP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
2 x 10A SP MCB 6kA	Light Circuits L2 to L3
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
4 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P4
1 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1
1 x 63A SP MCB kA	Feed to DB-E

The above section is fed from LV Kiosk with a 16mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.10 Distribution Board –DB-G

The Distribution Board is to be partially type tested assembly.

Name:	DB-G
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	100A
Fault Level:	6kA
Voltage:	400V
Surge Arrestors:	Yes
Spare space:	30%
1 x 63A TP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
2 x 10A SP MCB 6kA	Light Circuits L2 to L3
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
4 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P4
1 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1
1 x 30A TP MCB kA	Feed to DB-H

The above section is fed from LV Kiosk with a 10mm² 4 Core PVC/SWA ECC/PVC Copper Cable

16.11 Distribution Board –DB-H

The Distribution Board is to be partially type tested assembly.

Name:	DB-H
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	100A
Fault Level:	6kA
Voltage:	400V
Surge Arrestors:	Yes
Spare space:	30%
1 x 63A TP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
2 x 10A SP MCB 6kA	Light Circuits L2 to L3
3 x 63A SP MCB 6kA	Feed to Earth Leakage Units
3x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
7 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P7
5 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1 to DP5
1 x 30A TP MCB kA	Feed to DB-H
2 x 6A SP MCB kA	Ceiling Sweep Fan Circuits P9 to P10
2 X 20A SP MCB kA	Feed to A/C Circuits P10 to P11

The above section is fed from LV Kiosk with a 10mm² 4 Core PVC/SWA ECC/PVC Copper Cable

16.12 Distribution Board –DB-J1

The Distribution Board is to be partially type tested assembly.

Name:	DB-J1
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	80A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 63A SP Isolator 6kA	Main Switch
1 x 30A SP MCB 6kA	Feed to DB-J2
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
3 x 10A SP MCB 6kA	Light Circuits L2 to L4
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
6 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P6
1 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1
1 x 6A SP MCB 6kA	Extract Air Fan Circuits P3

The above section is fed from DB-M with a 10mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.13 Distribution Board –DB-J2

The Distribution Board is to be partially type tested assembly.

Name:	DB-J2
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	80A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 45A SP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
3 x 10A SP MCB 6kA	Light Circuits L2 to L4
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
6 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P6
1 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1
1 x 6A SP MCB 6kA	Extract Air Fan Circuits P3

The above section is fed from DB-M with a 10mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.14 Distribution Board –DB-K1

The Distribution Board is to be partially type tested assembly.

Name:	DB-K1
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	80A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 63A SP Isolator 6kA	Main Switch
1 x 30A SP MCB 6kA	Feed to DB-K2
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
4 x 10A SP MCB 6kA	Light Circuits L2 to L5
3 x 63A SP MCB 6kA	Feed to Earth Leakage Units
3 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
7 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P7
1 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1
1 x 6A SP MCB 6kA	Extract Air Fan Circuits P4

The above section is fed from DB-M with a 10mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.15 Distribution Board –DB-K2

The Distribution Board is to be partially type tested assembly.

Name:	DB-K2
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	80A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 45A SP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
4 x 10A SP MCB 6kA	Light Circuits L2 to L5
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
5 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P5
1 x 6A SP MCB 6kA	Extract Air Fan Circuits P3

The above section is fed from DB-K1 with a 10mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.16 Distribution Board –DB-L

The Distribution Board is to be partially type tested assembly.

Name:	DB-L
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	100A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 80A SP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
2 x 10A SP MCB 6kA	Light Circuits L2 to L3
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
5 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P5
1 x 20A SP MCB 6kA	Dedicated Plug Circuits DP1
1 x 50A SP MCB 6kA	Feed to DB-K1

The above section is fed from LV Kiosk with a 16mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.17 Distribution Board –DB-M

The Distribution Board is to be partially type tested assembly.

Name:	DB-M
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	100A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 63A SP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
2 x 10A SP MCB 6kA	Light Circuits L2 to L3
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
4 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P4
1 x 40A SP MCB 6kA	Feed to DB-J1

The above section is fed from LV Kiosk with a 16mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.18 Distribution Board –DB-N

The Distribution Board is to be partially type tested assembly.

Name:	DB-N
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	60A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 45A SP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
3 x 10A SP MCB 6kA	Light Circuits L2 to L4
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
5 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P5

The above section is fed from DB-P with a 10mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.19 Distribution Board –DB-P

The Distribution Board is to be partially type tested assembly.

Name:	DB-P
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	60A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 45A SP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
3 x 10A SP MCB 6kA	Light Circuits L2 to L4
2 x 63A SP MCB 6kA	Feed to Earth Leakage Units
2 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
5 x 20A SP MCB 6kA	Normal Plug Circuits P1 to P5
1 x 30A SP MCB 6kA	Feed to DB-N

The above section is fed from LV Kiosk with a 10mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.20 Distribution Board –DB-Q

The Distribution Board is to be partially type tested assembly.

Name:	DB-Q
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	60A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 30A SP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
1 x 20A 4P Contactors with 230V Coil supplying.	
2 x 10A SP MCB 6kA	Area Lighting Circuits L3 to L4
1 x 10A SP MCB 6kA	Light Circuits L2
1 x 63A SP MCB 6kA	Feed to Earth Leakage Units
1 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
1x 20A SP MCB 6kA	Normal Plug Circuits P1

The above section is fed from DB-D1 with a 6mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.21 Distribution Board –DB-R

The Distribution Board is to be partially type tested assembly.

Name:	DB-R
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	60A
Fault Level:	6kA
Voltage:	230V
Surge Arrestors:	Yes
Spare space:	30%
1 x 45A SP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
1 x 20A 4P Contactors with 230V Coil supplying.	
2 x 10A SP MCB 6kA	Area Lighting Circuits L3 to L4
1 x 10A SP MCB 6kA	Light Circuits L2
1 x 63A SP MCB 6kA	Feed to Earth Leakage Units
1 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
1x 20A SP MCB 6kA	Normal Plug Circuits P1
1 x 25A SP MCB 6kA	Feed to DB-B

The above section is fed from DB-C1 with a 10mm² 3 Core PVC/SWA ECC/PVC Copper Cable

16.22 Distribution Board –DB-S

The Distribution Board is to be partially type tested assembly.

Name:	DB-S
Mounting:	Flush wall mounted
Doors:	Yes
Meters:	No
Colour:	White, Colour B26 of SABS 1091
Supply:	Bottom entry
Busbars rating:	100A
Fault Level:	6kA
Voltage:	400V
Surge Arrestors:	Yes
Spare space:	30%
1 x 50A TP Isolator 6kA	Main Switch
1 x 10A SP MCB 6kA	PEC Circuit Controlling
1 x 10 SP MCB 6kA	Exterior Light Circuit L1
1 x 20A 4P Contactors with 230V Coil supplying.	
4 x 10A SP MCB 6kA	Area Lighting Circuits L3 to L6
1 x 10A SP MCB 6kA	Light Circuits L2
1 x 63A SP MCB 6kA	Feed to Earth Leakage Units
1 x 63A DP Earth Leakage Unit 30mA 6kA supplying.	
1x 20A SP MCB 6kA	Normal Plug Circuits P1

The above section is fed from LV Kiosk with a 10mm² 4 Core PVC/SWA ECC/PVC Copper Cable

17.

LOW VOLTAGE DISTRIBUTION CUBICLES (KIOSKS)

17.1 General

This Specification covers the manufacture of distribution kiosks for general reticulation and distribution systems in normal environmental conditions for three-phase, four wire, 400/230V, 50Hz systems.

17.2 Size

Kiosks shall be of ample size to accommodate the specified equipment and provide space for future requirements, as specified.

17.3 Moisture and Vermin

Kiosks shall be weatherproof. To prevent the ingress of water onto live equipment, the door entry surrounds shall have a channel shape, at least 12mm deep, to accommodate the door edge.

The roof shall be constructed with an overhang above non-continuous panelling and shall be provided with a drip-edge.

17.4 Ventilation

Two ventilation grilles or slots, approximately 150 x 125mm, vermin-proofed and insect-proofed by means of 1,5mm brass mesh or perforated steel plate spot welded on the inside, shall be provided on the top and bottom of both side panels.

The construction of the grilles shall prevent the ingress of rain or water.

17.5 Sheet Steel Canopies

Where specified, the canopy and doors shall be manufactured of 3CR12 steel to the following requirements:

A metal framework shall be manufactured from solid angle iron, channel iron or 2,5mm minimum folded sheet steel.

Joints shall be non-continuously butt-welded. Welds shall be ground smooth and the joints wiped with plumber's metal in order to provide a smooth finish.

Side panels, doors and the roof shall be manufactured from 2mm minimum sheet steel. The panels shall have upturned edges which are recessed in the frame or which fit over lips on the frame. The side panels may be either bolted or welded on the frame or form part of the folded metal frame.

The roof of the cubicle shall be removable and shall be fitted by means of bolts which shall be accessible from inside the cubicle only.

All panels and doors shall be suitably braced and stiffened to ensure rigidity and to prevent warping.

The steel canopy and framework shall be fixed to the base frame by four M16 high tensile steel bolts.

17.5.1 Finish and Colour of Sheet Steel Kiosks

Metal components of the framework, panels and doors shall be painted in accordance with the Engineer "STANDARD PAINTING SPECIFICATION".

The colour shall be "BISCUIT" Colour B64 or "LIGHT STONE" Colour C37 of SANS 1091. A tin of matching touch-up paint (not smaller than 500ml) shall be provided with each consignment.

17.5.2 Doors

Doors shall be fitted to the front and to the rear of each cubicle. The doors shall provide free access to equipment which has to be operated and shall provide a full view of all meters. Cubicles wider than 700mm shall be provided with double doors.

Doors shall have well-returning edges to fit into the channel of the door entry surrounds.

Doors shall swivel through 135°.

Brass hinges shall be used to hang the doors. The hinges shall be bolted to the canopy with brass bolts and nuts. Bolt heads or nuts shall not protrude beyond the outer surface of the kiosk. Nylon, aluminium or piano hinges are not acceptable.

Doors shall be fitted with lever locks equal or similar to the "BARKER & NELSON" type with a 135° movement. The locking mechanism shall have a catch on the rear which catches behind the frame or door entry surround. The locking mechanism, as well as the catch support area, shall be backed with brass or galvanised steel plates. The locking mechanism shall be padlockable. Padlocks will be approved by the Engineer, unless otherwise specified in the Specification.

The locking mechanism shall be made of brass or stainless steel.

Door restraints shall be provided. Cloth or canvas straps are not acceptable. The fixing points of the restraint at both the door and canopy shall be reinforced.

At least three hinges shall be supplied on steel doors higher than 1,2m.

Doors shall be fitted with neoprene or equivalent seals.

Metal doors shall be earth bonded to the frame by means of a copper braided strap, tooth washers, bolts and nuts.

17.5.3 Equipment Support Frame

A free-standing, angle iron or similar type rigid support framework shall be provided.

The frame shall be bolted down on the base by four M16 high tensile steel bolts. The holding-down bolts shall be accessible from the inside of the cubicle only. The frame of sheet steel canopies shall be bolted to the canopy framework.

A galvanised steel cable gland plate shall be bolted to the bottom of the frame across the full width of the cubicle to cover the cable entry opening in the base.

The gland plate shall be suitably punched to accept the number and size of cables specified.

A panel of “DELARON” or “THIOLITE” resin bound synthetic wood or other suitable dielectric material shall be provided for the mounting of all equipment and busbars. Impregnated hardboard, other treated or untreated wood products are not acceptable.

Alternatively, all equipment and busbars shall be flush-mounted within a purpose-made sheet metal frame enclosed by a machine-punched removable front panel through which the operating handles of the equipment protrude. Care shall be exercised that the rear studs of circuit breakers are properly insulated from the steel chassis.

17.5.4 Concrete Bases and Base Frames

To ensure stability of the kiosk after installation, it shall be mounted on a base frame which, in turn, shall be bolted to a concrete base cast onto the bottom of the cable trench.

The base frame shall be constructed of angle iron, at least 50x50x4mm thick and shall be of welded construction hot-dip galvanised and coated with epoxy resin tar.

The vertical height of the box frame shall be at least 900mm and the construction shall be such as to provide a rigid support for the kiosk.

The base frame shall protrude to a maximum height of 200mm above ground level. Provision shall be made for the protection and concealing of the cables entering the kiosk and to prevent access of animals and vermin.

The base frame shall be secured by at least four M16 bolts to the support frame of the kiosk and four M16 bolts and nuts to the concrete base. The bolts, nuts and washers shall be galvanised and supplied with the kiosk.

All galvanising shall be to SANS 763.

The kiosk manufacturer shall supply a detailed drawing of the base frame and the concrete base required.

Alternative designs and materials for the base (or root) of the kiosk will be considered, but full details must be submitted for approval by the Engineer.

18. CONDUIT AND ACCESSORIES

Unless other methods of installation are specified for certain circuits, the installation shall be in conduit throughout. No open wiring in roof spaces or elsewhere will be permitted.

The conduit and conduit accessories shall comply fully with the applicable SANS Specifications as set out below and the conduit shall bear the mark of approval of the South African Bureau of Standards.

- (a) Screwed metallic conduit and accessories: SANS 1065 Part 1 & 2.
- (b) Plain-end metallic conduit and accessories: SANS 1065 Part 1 & 2.
- (c) Non-metallic conduit: SANS 950.

The installation shall be in galvanised steel conduit. All conduit shall be concealed in the building work where possible.

The conduit shall be supported and fixed with saddles with a maximum spacing of 1m, even in roof spaces (refer to SANS 10142). The Contractor shall supply and install **ALL ADDITIONAL SUPPORTING TIMBERS REQUIRED**.

The conduit is to be clear of moisture and debris before wiring is commenced.

Chasing must be limited to the absolute minimum. No chasing by hammer and chisel will be accepted. Slots for conduits must be cut where necessary.

18.1 **Conduit in Roof Spaces**

In roof spaces, the conduit shall be installed in such a manner as to allow for all wiring to be executed from below the ceilings.

Conduit in roof spaces shall be installed parallel or at right angles to the roof members and shall be secured at intervals not exceeding 1,0m by means of saddles screwed to the roof timbers. Nails or cramps will not be allowed.

18.2 **Conduit in Concrete Slabs**

In order not to delay building operations, the Contractor must ensure that all conduits and other electrical equipment, which are to be cast in the concrete columns and slabs, are installed in good time.

The Contractor shall have a representative in attendance at all times when the casting of concrete takes place.

Draw boxes, expansion joint boxes and round conduit boxes are to be provided where necessary.

Before any concrete slab is cast, all conduit droppers to switchboards shall be neatly spaced and rigidly fixed.

18.3 **Pressed Steel Switch Boxes**

All switch boxes are to be manufactured from heavy gauge sheet metal and should be galvanised. The boxes are to be fitted with the necessary number of lugs to suit the number of switch units for which the box is intended.

Lugs are to be drilled and tapped at 82mm centres suitable for fixing either flush switch or standard flush plug units. Fixing screws must be provided.

The dimensions of the single gang boxes are to be approximately 50mm wide by 50mm deep by 100mm long, with one knock-out at each end and at the back and at least two knock-outs in each side.

The boxes must comply with SANS 1085.

All knock-outs are to be 20mm in diameter, suitable for 20mm electrical conduit.

19. **WIRING**

Wiring shall be carried out in conduit throughout. Only one circuit per conduit will be permitted.

No wiring shall be drawn into conduit until the conduit installation has been completed. All conduit to be clear of moisture and debris before wiring is commenced.

Switch socket circuits shall be wired by means of 4mm² phase conductors and a 2,5mm² earth conductor in 20mm diameter conduit, unless otherwise indicated.

Wiring for lighting circuits is to be carried out with 2,5mm² conductors with 2,5mm² earth conductors. In all other instances the number and size of cables drawn into any conduit, shall be as specified or shown on the drawings. Sizes and numbers of cables not specified, must be determined in accordance with Standard Regulations.

THE LOOP-IN SYSTEM SHALL BE FOLLOWED THROUGH OUT AND NO JOINTS OF ANY DESCRIPTION WILL BE PERMITTED.

The wiring shall be done in PVC insulated 600/1000V grade cables to SANS 1574.

Where cable ends connect onto switches, fittings, etc. the end strands must be neatly and tightly twisted together and firmly secured. Cutting away of wire strands of any cable will not be allowed.

Where earth conductors end onto switches, fittings, etc. the two end strands must be neatly and tightly twisted together and then firmly secured by a ferule. A single conductor must be secure at the other end of the ferule. The single conductor must be connected to the switches, fittings, etc.

20. **SWITCHES AND SOCKET OUTLETS**

20.1 **Light Outlets and Switches**

Light switches must be Crabtree Range or other SABS approved. Light switches shall be flush mounted and installed 1400mm above finished floor level.

Provide lighting outlets throughout the building as schedules and shown on the drawing.

Additional wood brandering shall be provided for the fixing of surface light fittings. No butterfly clips are acceptable.

20.2 **Switched Socket Outlets**

Socket outlets shall be installed in the positions indicated on the drawings. Socket outlets must be the Crabtree Range or other SABS approved.

Socket outlets in plaster or face brick walls shall be flush-mounted in 100 x 100 x 50mm deep pressed metal boxes, with cover plates similar to those for switches. Only socket outlets from the same manufacturer will be accepted.

Switched socket circuits shall be protected by means of earth leakage units as detailed.

Socket outlets shall be mounted at a height of 450mm above finished floor level unless otherwise indicated on the drawings.

21. **POWER SKIRTING**

The Contractor shall be responsible for the supply and installation of all powerskirting complete with corner pieces, end pieces, junction pieces, supply conduits, cover plates, power outlets and outlets for other services as specified and indicated on the drawings. All outlets installed on powerskirting shall be labelled.

The top compartment shall be used for switch socket outlets, whilst the lower compartment would be fitted with a divider for future telephone and data services.

If more than one circuit is installed in the same wireway, the conductors of each separate circuit, including earth conductor, shall be taped at intervals of 1m with PVC insulation tape.

Standard 16 Amp 3-pin flush switch socket outlets 100 x 50mm normal size shall be supplied and installed in the position indicated on the drawing and as specified.

The powerskirting must comply with SANS IEC 61084-1 and 61084-2-1. The Contractor must ensure that the powerskirting is installed to the satisfaction of the Engineer before commencing with the wiring thereof.

The powerskirting shall be of the “O-line 2 compartment 2 cover power skirting including internal divider – PVC type or other SABS approved.

22. **COVERPLATES**

All Coverplates shall be manufactured of the plastic type and shall be of the colour grey or to be determined by the Architect on site.

23. **ENGRAVING OF CIRCUITS ON COVERS**

All switches, switch socket outlets, isolators, telephone, etc. outlets, shall have the covers engraved with the distribution and circuit number from which it is fed. Where covers cannot be of the plastic type, engraved plastic labels are to be fixed on the cover.

24. **LUMINAIRES**

The Contractor will be responsible for the supply and delivery of luminaires, including lamps. The Contractor shall be required to allow for the administration, attending to timeous delivery, for storage on site, for handling all items and replacements, etc. and tenderers shall include their cost for this attendance and the cost for profit and handling on the supply of luminaires.

All fluorescent lamps shall comply with the SANS 1041 as revised and shall be 4 300°K cool white.

24.1 **Schedule of Luminaires**

TYPE	DESCRIPTION
A	The Luminaire shall be LIHLE, or other SABS approved 2 x 18W LED T8 Tubes Surface Mount LBR 1200 x 300MM
B	The Luminaire shall be LIHLE, or other SABS approved 2 x 24W LED T8 Tubes Surface Mount Open Channel 1500MM
C	The Luminaire shall be LIHLE, or other SABS approved 2 x 24W LED T8 Tubes Surface Mount Vapour Proof 1500mm IP65.
D	The Luminaire shall be LIHLE, or other SABS approved 15W LED recessed Downlight 1P20 Ceiling Mounted Fitting.
E	The Luminaire shall be LIHLE, or other SABS approved 5W LED Red Safety light with a Pilot Light and Buzzer Recessed to a PVC box.
F	The Luminaire shall be LIHLE, or other SABS approved LED Linear W75 x 75H x L22100MM IP29 Complete with Suspension Kit.

TYPE	DESCRIPTION
G	The Luminaire shall be LIHLE, or other SABS approved 15W LED Die Cast Round Bulkhead IP65 1980lm ceiling/wall mounted at 2200mm AFFL
H	The Luminaire shall be LIHLE, or other SABS approved LED Exit Luminaire, Complete with Emergency Battery Backup.
I	The Luminaire shall be LIHLE, or other SABS approved 50W LED Suspended Luminaire W200 x 80H x L1500MM with LBR Reflector.
J	The Luminaire shall be LIHLE, or other SABS approved 500W LED Floodlight IP65 Mounted on a 9000mm Pole.
K	The Luminaire shall be LIHLE or other SABS approved 20W LED E27 Post Top Black 2000lm with 3.5 metre HDG Black Pole with MCB.

If specified light fittings are not available, the Engineer accepts other SABS approved.

The Contractor is to ensure that all luminaires are to be equipped with all fittings and accessories necessary for their complete installation.

In the case of the commodity complying with a compulsory specification, the manufacturer or agent shall furnish an Authorisation Mark. The new SANS Safety Specification will supersede all compulsory specifications.

25. **TELEPHONE INSTALLATION**

Lockable 450 x 450 x 150mm deep, flush-mounted distribution board with an architrave frame and door must be used for the telephone installation. A soft wood backing must be provided in this box. The Electrical Contractor must confirm the external dimensions with the Local Authority before any order is placed.

The outlet boxes must be 100 x 100 x 50mm with blank covers and mounted 450mm above finished floor level.

25mm diameter PVC conduit must be used for the telephone installation.

Draw wires must be installed.

The termination box must be labelled "Telephone" and must be mounted 500mm above finished floor level.

26. **SIREN**

The siren must be suitable to operate on a 230V, 50Hz supply and the entire siren system must be controlled by a Timer Switch installed in the Administration building. The Siren must be of the 203mm Gents type.

A 20A, two pole isolator must be mounted next to the bell. A label with the wording "Danger Supply is from Admin MAIN - DB" must be mounted on the isolator or on the wall next to the isolator at the bell, i.e. a suitable York box or similar approved box.

27. **EARTHING ELECTRODES**

27.1 **General**

This section covers uncoated, coated and metal clad circular rod electrodes intended to provide an earth in soil for electrical and lightning arrestor systems.

27.2 **Category and Type**

27.2.1 Only the following type of earthing rods shall be used:

- 1 (a) Solid copper.
- 1 (b) Solid stainless steel.
- 2 (a) Solid steel with bonded copper protection.
- 2 (b) Solid steel with plated copper protection.
- 2 (c) Solid steel with a shrunk-on copper jacket.
- 3 Solid steel with a shrunk-on stainless steel jacket.
- 4 Galvanised steel.

27.2.2 Bare aluminium is not acceptable as an electrode material.

27.2.3 All rods shall be solid and of circular cross section with lengths as specified.

27.2.4 The nominal diameter of the earthing rods shall not be less than 16mm unless the rods are specified for placing in pre-drilled holes, in which event the minimum nominal diameter shall not be less than 12mm.

27.3 **Couplings and Conductor Clamps**

Earthing electrodes shall be provided with (n-1) couplings, where n = number of rods supplied.

Rods designed for coupling by means of external sleeves shall be provided with an adequate quantity of hydrocarbon or silicon grease to be applied to the coupling before the joint is made.

Rods designed for coupling by means of internal pins or splines shall be provided with tin-walled tubes and hydrocarbon or silicon grease to seal the joint.

The material of the clamps shall be electrolytically compatible with the rod and conductor materials.

Where brazed or welded connections are specified, the supplier of the rods shall stipulate at least two types of metals which are compatible with the rod and conductor materials.

27.4 **Earth Clamps**

Earth clamps shall consist of copper strips at least 1,2mm thick and not less than 12mm wide secured with a brass bolt, nut and washer and shall be so constructed that the clamp will fit firmly to the conduit without any additional packing.

28. **EARTHING OF INSTALLATIONS**

The type of main earthing must be as required by the supply authority, of other than the Engineer,

who may require additional earthing to meet the test standards.

Installations shall be effectively earthed in accordance with the “Standard Regulations” and to the requirements of the supply authority, as well as the Engineer, who may require additional earthing to meet the test standards. Earthing must comply to SANS 10142.

All hot and cold water as well as waste pipes must be effectively bonded by 12,5 x 1,6mm solid or perforated copper tape (not wire) clamped by means of brass bolts and nuts. The tape is to be fixed to walls by means of roundhead brass screws at intervals not exceeding 150mm.

The earth connection from the main earth bar in the main board must be made to the cold water main and the incoming service earth conductor by means of 16mm² stranded (not solid) bare copper earth wire or such conductor as the Engineer may direct. Where applicable, all steel roof sheeting as well as steel walkways and stairs shall be suitably earthed.

Furthermore an earth electrode (earth spike) of at least 1,5m long must be provided and driven into the ground at the centre of each gable-end wall of each individual block. These earth electrodes shall be installed at least 1m from the building’s perimeter and shall clear all aprons and water channels. These earth spikes must be driven into the ground to at least 300mm below ground level and only after final bonding and tests have been carried out must proper backfilling and compacting of same be executed.

In each instance these earth spikes must be interconnected by means of a 70mm² stranded bare copper earth conductor which must be installed in the inside of the ridging of the roof structure encased in 20mm conduits installed in the gable walls. This earth conductor must be bonded to the roof sheeting at intervals not exceeding 5m, ensuring that roof sheeting on both sides of the ridging are properly bonded.

The overall earth resistance at the main distribution board shall not exceed 1 ohm. The Contractor shall assess the soil and site conditions at the time of tendering and allow for this to enable him to perform the proper earthing and bonding of all installations.

29. **MAINTENANCE REQUIREMENTS**

The maintenance period of 12 months from handover, is detailed in the contract conditions and contract preliminaries. It is, however, a further requirement of this contract that three months after handover of the installation, all faulty lamps and tubes shall be replaced by the Contractor at no additional cost to the Employer. The replacement parts such as tubes, lamps, starters, ballast, etc. will be supplied and delivered by the Contractor and he shall include in his tender price for all other costs associated with this requirement.

It is a further requirement of this contract that the Contractor with local contractors to perform the maintenance function on his behalf during the maintenance period. Details of this arrangement shall be provided within 14 days of acceptance of the contract. It should furthermore be noted that the maintenance requirements entail a 24-hour call-out 7 days a week during the maintenance period and in all cases, a response time of less than one hour is required.

30. **LOAD BALANCING**

The Contractor is required to balance the load as equally as possible over multi-phase supplies.

31. **ITEMS FOR COMMENT**

The right is reserved to reject any equipment which does not, in the opinion of the Engineer, conform to specification or which is of an inferior grade. Should such equipment be rejected, the

Contractor shall at his own expense provide for alternative equipment and tenderers are thus warned to ensure that all equipment offered is in strict accordance with the requirements of this specification.

In certain cases the Contractor may be required to submit samples and where necessary, tests will be performed to establish the quality of the material offered.

32. **CONTRACT ADMINISTRATION, COMPLETION, TESTING AND COMMISSIONING**

32.1 **Quality Control During the Execution of the Contract**

The Contractor or his authorised representative, to ensure that all work is executed in accordance with the drawings, specifications and regulations, shall carry out day by day inspections of the Works. The Engineer will monitor these inspections.

32.2 **Standard of Workmanship**

All installation work in this contract is to be executed by qualified electricians and cable jointers in accordance with modern techniques. The Engineer shall have the right to reject any work which does not meet the specification or which is not in accordance with standard practice.

32.3 **Maintenance of As-Built Drawings**

During execution of the contract, the Contractor shall update the drawings daily with all the relevant information.

At the end of the contract and prior to handover being accepted, the Contractor shall prepare as-built drawings of the installation. These drawings shall be a set of the latest drawings issued by the Engineer on which the Contractor shall highlight all changes. The Contractor shall take great care to ensure that all underground services are shown in the correct places.

The Contractor shall also issue three sets of drawings, wiring diagrams, service and instruction manuals for equipment supplied by him and these will have to be acceptable to the Engineer prior to handover being approved.

32.4 **Preliminary Testing of Major Equipment**

All terms of major equipment are, where feasible, to be factory tested prior to delivery to site, and results of such tests, in a format to be agreed in advance, are to be produced before the equipment is delivered.

All such tests are to be in accordance with the relevant codes of practice, and with any other requirements as set out in this document.

32.5 **Completion of Installation**

Before the commencement of any test or commissioning procedures, the Contractor is to ensure that all nuts and bolts are securely fastened, and that paintwork on all items supplied has been touched up where damage has occurred.

32.6 **Inspection and Testing**

On completion of the entire installation or any particular section thereof, as may be decided by the Engineer, tests shall be carried out in full accordance with the current edition of the "Code of Practice for the Wiring of Premises", in the presence of the Engineer.

The Contractor should note that, where applicable, at least the following tests must be carried out:

- Insulation test.
- Continuity test.
- Loop Line Earth Line Impedance test.
- Polarity test.
- Earth Leakage Circuit Breaker test.
- Earth termination test.

Any further tests as deemed necessary by the Engineer.

The results of the above tests must be clearly recorded, signed and handed to the Engineer together with a Certificate of Compliance and any other form or forms as required by the Employer.

32.7 **Documentation**

The following documentation is required and shall be provided by the Contractor:

- Set of schematic wiring and function diagrams.
- Operating and maintenance instructions on equipment.
- Guarantees ceded to Employer.

Once the Engineer has inspected the complete installation and satisfied himself that all testing has been completed and the contract is complete in all respects, will he issue a letter to the Employer stating installation is complete.

32.8 **Labelling**

All switchgear and equipment installed in the switchboards, plus isolator boxes, cables, etc. shall be clearly labelled as indicated elsewhere in this specification and schedules.

32.9 **Training of Institutional Staff**

Where applicable, allowance is to be made by the Contractor for the training of Institutional Staff in the setting up and operation of the various items of equipment supplied under the contract.

32.10 **Testing and Commissioning Documentation**

On completion of the testing and commissioning, the following documents shall be compiled and presented to the Engineer.

- (a) A Certificate of Compliance and other form/s as required by the Engineer and Employer.
- (b) Drawings of the installation marked up "As-Built" as described elsewhere.
- (c) Completed set of test and commissioning sheets.

First delivery will not be taken unless above mentioned items are complied with.

33. **TESTING AND INSPECTION**

The Contractor shall test the entire installation in conjunction with and to the satisfaction of the Supply Authority and in the presence of the Engineer. The Contractor shall make all

arrangements for testing and inspection, the costs thereof being included in the tender price.

All 220V socket outlets shall be tested for polarity and sensitivity of the earth leakage protection equipment shall be tested by means of an approved instrument.

Each length of cable shall be tested for insulation and polarity by means of a 1000V megger designed for that purpose. In the case of underground cables, this shall be done before backfilling. In addition, the earth-loop impedance of each main and sub-main feed shall be measured. The earth resistances shall be tested by means of an approved instrument.

If there is no power on the day of the test, the Contractor shall supply a 3kW, 230V generating plant for testing purposes.

“DANGER” notices shall be displayed at the remote ends of cables under test.

The Engineer reserves the right to witness all tests. The Contractor shall advise the Engineer in writing of all results and furnish copies of all certificates.

Load balancing shall be undertaken by the Contractor in conjunction with the Engineer. Where conductors are altered to achieve satisfactory results, they shall be re-laced by the Contractor.

The Contractor shall provide all the necessary instruments for the proper testing of the complete installation. If there is reason to doubt the accuracy of such instruments, the Contractor shall take the necessary action to prove their accuracy.

If the results of the first delivery tests are favourable and the installation is found to be in order, there will be no charge for the test. If the test is found to be unfavourable, a levy of R200-00 will be charged to the Contractor for each subsequent test in the form of a Variation Order omitting such costs from his contract price.

The Contractor shall ensure that the installation is complete in every respect and that there are no major defects prior to notifying the Engineer (in writing) of a first delivery inspection.

Should there be any minor defects upon final inspection, the Engineer will terminate that inspection and request that an additional final inspection be arranged by the Contractor.

HEUWELLAND SCHOOL
ELECTRICAL INSTALLATION
FOR
DEPARTMENT OF EDUCATION
IN THE
KING CETSHWAYO DISTRICT
FOR THE
DEVELOPMENT BANK OF SOUTH AFRICA
PROVINCE OF KWAZULU-NATAL
ELECTRICAL INSTALLATION
PART 3: SPECIAL FACILITIES AND EQUIPMENT

1. Fire Detection and Public Address System
2. Data, Telephone and PABX Installation
3. CCTV and Alarm System
4. Access Control and Intercom System

1. **FIRE DETECTION SYSTEM**

1.1 **GENERAL**

This Sub-Contract covers the supply, delivery, installation, commissioning and handing over in approved working condition of an early warning Addressable Fire Detection is specified herein and as indicated on the drawings. The extent of the Fire Detection Installation will basically be as follows:

- New Buildings which consist of 2 Multipurpose Classroom building, Media Centre building, Computer Room building, Guard House building and Existing Administration building.

1.2 **SCOPE OF WORK**

The Scope of the Contract is generally for a Specialist Sub-contract to supply, deliver, install, test, commission and hand over in full working order:

- An addressable Fire Panel linked to the new Fire Detection Network at the 2 Multipurpose Classroom building, Media Centre building, Computer Room building, Guard House building and Existing Administration building.
- Fire Retardant cable installed in the conduits and wire-ways installed by the Electrical contractor.
- All the Detectors, Manual Call Points and sirens for the Fire Detection system.
- A guarantee period of 12 months with free service and maintenance shall be provided for the systems.
- Testing and commissioning of the fire detection installation.
- Demonstrate the System operation to the Client and the Handing over of 3 sets of Comprehensive O & M Manuals.

1.3 **TECHNICAL SPECIFICATION**

1.3.1 **Pre-amble**

1.3.1.1 The installation shall be suitable for operation at the altitude and under the atmospheric conditions outlined in the Schedule of Details.

1.3.1.2 The onus is on the Tenderer to ascertain any other local conditions or peculiarities which might affect the working of the system, and no allowance in price or standard of materials and workmanship will be made for any ignorance on the part of the tenderer in this respect. This also applies to the nature and construction of the building, details of which can be obtained from the Principal Agent.

1.3.1.3 Tenderers shall include for everything required for the completion and successful operation of the installation, whether such items are expressly mentioned or not.

1.3.2 Quality of Material

1.3.2.1 Only material of first quality shall be used. All material is subject to the approval of the Engineer.

1.3.2.2 Where applicable, all materials must comply with the relevant standard specifications of the South African Bureau of Standards or the British Standard Specifications.

1.3.3. Standard of Workmanship

1.3.3.1 The whole of the above installation shall be executed in accordance with the best modern practice, and the Engineer shall have the right to reject, and demand satisfactory replacement at the Contractor's cost, of any part of it which, in his opinion does not conform to the highest standards of material and workmanship. This includes parts that are not easily available for maintenance or repair. In case of ready-made circuits, the connections shall be done neatly and according to approved standards.

1.3.3.2 If required by the Engineer, the Contractor shall perform at his own cost such a test in the presence of the Engineer.

1.3.3.3 Responsibility of Contractor

The Contractor, by tendering, will have to satisfy himself as to all the conditions and circumstances affecting his tender and as to the general circumstances of the Site of Works, the Conditions of Contract and the Nature of the Work to be carried out under this contract. No claim by the Contractor for additional payment will be entertained which is consequent upon failure on his part to obtain correct information as to any matter affecting his tender or the execution of the work.

IT IS A SPECIFIC REQUIREMENT OF THIS CONTRACT THAT SPECIALISTS WHO ARE CONVERSANT WITH THIS TYPE OF WORK SHALL DO THIS PART OF THE WORK.

1.4. SUPPLY AND INSTALLATION

1.4.1 The contract shall include for the complete supply, delivery, installation, testing, commissioning and handing over in working order (to the satisfaction of the Engineer) of the fire detection installation as specified and shown on the drawings.

1.4.2 The contract shall include for all work, labour, material, plant, equipment and everything necessary for the completion of the whole installation in accordance with the requirements of the SANS standards, and no extras will be allowed on the contract price for non-compliance with these requirements.

1.5. MATERIAL AND WORKMANSHIP

- 1.5.1 The Contract works shall be executed in accordance with the specified standards and level of workmanship, to the satisfaction of the Head: Works.
- 1.5.2 All materials shall be of the quality specified and the Contractor shall, upon request of the Head: Works, furnish her with proof to her satisfaction that the materials are of the specified quality.
- 1.5.3 All materials and equipment used for the installations shall be new and undamaged.
- 1.5.4 The Contractor shall, if requested by the Head: Works, provide samples of material and equipment for approval. If judged necessary by the Head: Works, such samples may only be returned after the completion of the installation, in order to ensure that the quality of the installed product is the same as that of the approved sample.

1.6. REFERENCE SPECIFICATIONS AND STANDARDS

- 1.6.1 The latest revision of any Specification referred to in this specification, will be applicable.
- 1.6.2 All materials, components and equipment shall be new and of good quality and shall comply with the relevant SANS, SAPO, DIN or IEC specifications.

The latest amendments to the following standards form part of this specification:

SANS 10139-2000	User code for the prevention, automatic detection and extinguishing of fires in buildings.
BS 5839 : Part 1-1980	Fire detection and alarm systems for buildings.
BS 6266 - 1982	User code for the fire protection of electronic data processing installations.
SANS 10142-2003	The wiring of premises.

Any uncertainty which may arise regarding of the above shall be submitted to the Engineer in writing for clarification during the tender period.

The equipment shall be from standard stock. Component shall fit easily into each other and shall be designed for ease of maintenance and replacement.

All the materials and equipment used on site shall be suitable for use under local conditions, these include weather conditions, as well as conditions at the time of installation and operation. If the equipment and material are not suitable for the specific conditions, the contractor shall protect or replace defective equipment at his own cost.

All of the equipment offered shall be suitably protected against lightning and the contractor shall indicate which precautions he has taken to prevent lightning damage to his equipment.

- 1.6.3 The SI ("Le Systeme International d' Unites") – Metric System of Units will apply. Refer to SANS – M33A: The International Metric System: Guide to the use of the SI in South Africa.

1.7. DRAWINGS

1.7.1 Engineers Drawings

- 1.7.1.1 Unless otherwise specified, the Engineer's Tender drawings are not manufacturing drawings and the dimensions given are only sufficient for tendering purposes or to enable the Contractor to complete manufacturing drawings. It is the responsibility of the Contractor to verify all dimensions.

- 1.7.1.2 The Engineer shall make available to and at the request of the Contractor any available record drawings of the present installation.

1.7.2 Contractors Drawings

- 1.7.2.1 The Contractor will be furnished, on request, with the Engineer's drawings.

- 1.7.2.2 The Contractor shall supply two (2) copies of all shop drawings to the Engineer. The Engineer will scrutinize the shop drawings and grant the Contractor permission to proceed with the installation. All work done by the Contractor without permission from the Engineer to proceed, will be at the risk of the Contractor. Shop drawings shall include details and dimensions of all equipment to be installed under this contract. The drawings must show full details of the installation.

- 1.7.2.3 Two (2) copies of the certified drawing shall be issued to the Engineer for distribution.

- 1.7.2.4 The Contractor will be required to produce the shop drawings on the proposed system.

- 1.7.2.5 Unless otherwise specified, cable routes shall be superimposed on the Mechanical Layout Drawings, showing the runs and fixing details.

- 1.7.2.6 The Contractor shall update all shop drawings once the installation has been completed. One (1) set of paper prints and one (1) electronic copy of these as-built drawings shall be supplied to the Head: Works as part of the O & M Manual.

1.7.3 Equipment Drawings

The Contractor shall provide the Engineer with working drawings of all items of equipment, with a detail technical specification of the equipment before placing an order for the equipment.

1.8. MAINTENANCE AND GUARANTEE

The tenderer of this contract shall allow in his price for the maintenance of the complete installation for a period of twelve months starting from the date of first take-over of the contract by the Department.

It is a specific requirement of this contract that the contractor shall allow for 4 inspection visits during the 12 month maintenance period, and that he shall submit full reports for each visit. The reports shall contain the status of the system as well as the faults which occurred on the system during the previous 3 months.

A log book shall be supplied by the contractor. The log book shall be kept on site in charge of the responsible person appointed by the User Department for this purpose. The contractor shall complete the log book, showing all maintenance done by him, as well as repairs of faults which may have occurred.

The log book shall also contain the following information:

- Date
- Type of fault reported and by whom
- Date of fault report
- Work done
- Name and signature of person carrying out the work.
- Name and signature of the person in charge of the site.

The log book shall be filled in TRIPLICATE. One copy shall accompany the monthly report to the Regional Representative of the Department; one copy shall be for the contractor's own use, whilst the third copy shall remain in the log book as a record.

The contractor shall also allow for a complete maintenance service of the system after the twelve (12) month guarantee period. The log book shall also be filled in and reports submitted for this service to the Regional Representative of the Department.

The report shall be submitted to the Department within seven (7) days of the service. Serious faults shall immediately be reported to the Regional Representative and the Consulting Engineer by telephone.

No maintenance or repair work shall be done on site without the knowledge, and approval, of the responsible person in charge on the site.

The normal maintenance, which is, for example, necessary for the maintenance of batteries in the system, shall be clearly indicated in the documentation in a separate section.

1.9. **MAINTENANCE CONTRACT**

The Department can insist on a full maintenance contract with the installer (after completion of the maintenance period).

The duration shall be for one year. The Department shall make a decision in this regard after the completion of the maintenance period.

1.10. **OPERATING MANUALS**

The contractor shall supply three complete sets of operating manuals.

A shortened operating manual in English shall be supplied with all emergency procedures covered.

Operating manuals shall be provided in English and shall be easily readable.

Two sets of concept documents shall be handed to the Engineer and Department for approval and commentary. The manuals shall be handed over before first take-over.

The operating shall consist of the following with clear descriptions, as well as purpose of installation:

- (a) Paper copies of all approved drawings and diagrams.
- (b) Complete description of different components of installation.
- (c) On/off switch procedures.
- (d) Instruction for routine test carried out by user.
- (e) Detailed instructions for emergency procedures.
- (f) Emergency aid procedures.
- (g) Use of breathing apparatus.

1.11. **MAINTENANCE MANUALS**

Three complete sets of the Maintenance Manuals, in English only, shall be provided.

The manuals shall contain the following:

- (a) A complete set of 'as built' drawings of the contract, in a form acceptable to the Department. No drawings shall be smaller than A4 size. Large drawings shall be reduced to A3 or A4 size for inclusion in the manuals, provided they remain legible.
- (b) A complete set of "machine shop" drawings of the contract, showing dimensions, finishes, general arrangements of panels, consoles, computer assemblies, etc.
- (c) A complete set of wiring diagram drawings of all equipment, showing component identification, types and values.

- (d) A block diagram drawing for each piece of equipment containing more than one PC board, showing the interconnections of boards complete with connector and plug numbers, and PC board identification markings.
- (e) A complete list of all equipment containing the following information :
 - (i) Name of the equipment (or description thereof).
 - (ii) Serial number of equipment.
 - (iii) Type number of equipment.
 - (iv) Manufacturer of equipment.
 - (v) Equivalent replacement model of equipment (where applicable).
 - (vi) Names, addresses, telephones and facsimile numbers of firms supplying equipment.
 - (vii) Supplier's catalogues.
- (f) A complete and comprehensive description of the operation of the system and of each individual piece of equipment.
- (g) A complete and comprehensive description of the maintenance of the system and of each individual piece of equipment in respect of daily, weekly, monthly or annual maintenance.
- (h) Advanced technical information of the system may also be bound into the Maintenance Manuals as additional information. Any literature not in the English language, shall have the English translation attached.

A procedure to trace faults.

A concept copy of the Maintenance Manual(s) shall be submitted to the Department's consultant, at least two (2) weeks prior to the anticipated first hand-over of the installation for scrutinizing and possible amending.

- (i) CD with all the as-built drawings in AutoCAD format.

First delivery of the installation will not be taken, unless acceptable manuals are submitted prior to the first hand-over inspections.

1.12. **BLOCK PLANS**

The various zones with the corresponding reference numbers of the zone indications shall be shown on the block plans.

It shall be installed at the main panel and at the entrance doors to each zone.

The block plans shall be submitted to the Engineer for approval before installation.

The block plans shall be installed in proper wooden frames and shall be laminated in plastic. The plans shall be produced in such a manner that light fading will not occur.

1.13. **FRAMED INSTRUCTIONS**

Complete framed instructions in English shall be placed at the reception and fire panel positions.

1.14. **PREFERENCE LIST**

Preference shall be given to South African made equipment if they comply with all the technical specifications.

Imported equipment shall only be considered if there is no local product at a competitive price available.

It is one of the conditions of tender to complete the Preference List. If it is not done, the tender can be disqualified

1.15. **FIRE DETECTION SYSTEM**

1.15.1 **Approval of Equipment**

The tenderer shall indicate whether the equipment offered complies with the requirements of one or more of the following:

- (a) NFPA of the USA.
- (b) BS 5839.
- (c) BS 5446.
- (d) EN 54.

Notwithstanding anything mentioned above, all the equipment shall be acceptable to the Department.

1.15.2 **General Description**

The fire detection system shall comprise of a fire panel in the Guard House. It shall be connected to a link to the Fire Brigade office, a mimic in the Reception as indicated on the drawings and a complete set of information to the maintenance package in the Reception. All of these connections shall be done with a fire proof cable (PH30 minimum requirement).

The fire detection devices, alarms, control devices, etc., throughout the building shall be connected (A-class) to the fire panel. These connections shall be done with a fire proof cable (PH30 minimum requirement) 4 - core copper cable and the Contractor shall ensure that the integrity of the shield is in place throughout the installation. There shall be a mimic panel installed in the Reception which will indicate the layout of the devices on the floor plan of the zone.

The panel shall continuously monitor the analogue status of all sensing devices and initiate action when a fire or smoke condition is present. The main control panel

shall make the decisions regarding the state of the system from the information received from the field devices.

The alarm management shall be field configurable from the control panel via a keypad to enable the system to be tailored to suit the protected building and to permit future additions and changes. This configuration shall be maintained intact in memory. The control unit shall have a front panel comprising of indicating LED's, control keyboard and backlit LCD display, as described in detail later. The LED display will give details of any event, which occurs in the system.

Data ports are to be provided for communicating with remote LCD repeaters, intelligent numeric panels and graphics computers.

Control units shall be modular in design and shall have facilities for operating as stand-alone unit, or as part of a network.

All fire detectors and other relevant equipment shall be installed in the positions indicated on the drawings.

Whenever a fire situation arises, the air-conditioning shall be switched off via the wiring to each air-conditioning unit installed as part of this contract to a normally open relay in the air-conditioning unit.

1.15.3 **Equipment**

1.15.3.1 Analogue addressable detectors

All automatic detectors must be formally approved by at least two (2) of the internationally recognised testing laboratories listed below:

- * Underwriters Laboratories, USA (U.L.)
- * Verband der Schass Versekerer, Germany (VDS)
- * British Standards, Great Britain (BS)
- * Loss Prevention Certificate Board, Great Britain (LPC)
- * Underwriters Laboratories. Canada (ULC)

The detectors shall be suitable for connecting to a two-wire 24V central system and operate satisfactorily within the supply voltage range of 17V - 28V DC, and shall be polarity insensitive. A red indicator LED shall be provided on the detector, which illuminates when the detector has reached a pre-set alarm level. The indicator shall be operated independently of the detector from the central control panel. The indicator shall illuminate when there is a fire in the building.

Provision shall be made for an output from the detector suitable for operating a remote indicator or other device with a current limitation of 4 milli amps. The output shall be operated independently of the smoke detector from the central control panel.

Data transmission to and from the control panel from the detector shall be via communications circuitry which is factory fitted to the detector by the original detector manufacturer and forms a complete and integral part of the detector.

The detector shall be supplied complete and fully tested and calibrated. All detectors shall come standard with a locking mechanism.

Separate mounting bases shall be required which enable ready removal of the detectors for maintenance. The bases shall be fitted with dual finger steel receptacles.

The unique address of the detector shall be set by the installer by means of a coded plastic card fitted to the detector base. The base shall be electronics free.

The detector shall be capable of being remotely tested from the control panel by the transmission of a 3-bit code. The control panel will raise a maintenance alarm should this test fail.

1.15.3.2 Optical Smoke Detector

The photoelectric (optical) smoke detectors shall be suitable for detecting visible smoke such as is produced by slow smouldering fires including burning PVC.

They shall be of the light scattering type using a pulsed internal LED light source and a photo-diode sensor.

The detector shall be capable of operating within the following environmental limits:

Temperature operating range:	-20°C to + 60°C
Humidity operating range:	0% to 95% RH (no condensation)
Wind:	Not affected

The construction of the detector and bases shall be in white self-extinguishing polycarbonate plastic. Full circuitry must be protected against moisture and fungus. Smoke entry points must be protected against dust and insect ingress by corrosion resistant gauze. The optical chamber must be of conductive plastic and have a snap-lock fit for ease of removal when cleaning. The detectors must be unobtrusive when installed, having a dimension not exceeding 50mm x 100mm² diameter maximum including the mounting base.

The detector shall be capable of protecting an area up to 100 square metres at a height of up to 12m. The installation and siting of the detectors must conform to BS 5839 1988 or similar standards.

1.15.3.3 Heat Detectors

The device shall monitor ambient temperature by means of an NTC thermistor.

The detector shall be capable of operating within the following environmental limits:

Temperature operating range:	-20°C to + 60°C
Humidity operating range:	0% to 95% RH (no condensation)

Wind resistance: Unaffected

The construction of the detector and bases shall be in white self-extinguishing polycarbonate plastic. Full circuitry must be protected against moisture and fungus. The detectors must be unobtrusive when installed, having a dimension not exceeding 50mm x 100mm diameter maximum including the mounting base.

Each detector shall be suitable for protecting an area up to 50m² at a height of up to 7.5m. The installation and siting of the detectors must conform to BS 5839 1988.

1.15.3.4 Multi-Sensor Detectors

This detector shall combine inputs from optical and heat sensors, and process them using sophisticated algorithm. This detector is for use in place of ionisation detectors where the latter is too sensitive for the environment. It shall be sensitive to a wide range of fires using five different modes to identify.

Mode 1

High smoke and temperature sensitivity (smouldering and flaming fires)

Mode 2

Sensitivity similar to that of an optical detector with no response to temperature.

Mode 3

Moderate smoke sensitivity combined with moderate heat sensitivity

Mode 4

Reduced smoke sensitivity combined with high heat sensitivity.

Mode 5

No smoke sensitivity combined with normal heat detector response (threshold at 58°C).

Temperature operating range: -20°C to + 600°C

Humidity operating range: 0% to 95% RH (no condensation)

Wind resistance: Unaffected

The construction of the detector and bases shall be white self-extinguishing polycarbonate plastic. All circuitry must be protected against moisture and fungus. Smoke entry points must be protected against dust and insect ingress by corrosion resistant gauze. The optical chamber must be of conductive plastic and have a snap-lock fit for ease of removal when cleaning. The detectors must be unobtrusive when installed, having a dimension not exceeding 50mm x 100mm diameter maximum including the mounting base. Each detector shall be suitable for protecting an area up to 50m² at a height of up to 7.5m. The installation and siting of the detectors must conform to prEN54-5 and prEN54-7.

1.15.3.5 Detector Mounting Bases

The mounting base shall be suitable for being mounted on a flat surface or in a round electrical box having 50 mm hole centres.

The fitting of a detector into a base shall be a simple one-hand operation without risk of damage to the base or detector. The detector shall click home clearly which shall also be an indication that the detector is fitted correctly.

Each base shall be uniquely addressable and it shall be possible to change its address by altering or replacing the address card.

The address of a base shall remain undisturbed and unchanged by the removal or replacement of a detector. The base shall be electronics free.

Each base shall be provided with a durable tag on which a number or mark is displayed which shall identify the address of the monitor.

1.15.3.6 Manual Call Points

The call point shall be manufactured from self extinguishing red polycarbonate plastic.

The overall size of the call point shall not exceed 87mm x 87mm x 52mm.

The call point shall be based upon a standard product manufactured by a reputable call point manufacturer. The manual call point shall then be modified by the manufacturer of the heat and smoke detectors to incorporate a communications module within the call point. No external alterations to the call point shall be made other than the fixing of a flush mounted LED to be located to the right of the word "Fire" which shall appear in black letters across the top of the call point on the vertical face. The LED shall be red in colour.

The LED shall illuminate when the call point is activated. However, the illumination of the LED will be by command from the control panel.

Manual call point units shall be protected against ingress of dust and water to IP65, if so required. A unit mounted outside buildings shall be provided with a hood mounted over the unit.

A call point shall be addressable and compatible with the central control panel. The unit shall be provided with a means of testing. It shall be capable of responding when polled by the fire panel by transmitting its address and status code. It shall be capable of handling the central control panel poll rate.

The call point shall be polarity insensitive and shall be capable of operating by means of a 2-wire looped system.

The communication module will incorporate a special interrupt facility which shall override any other data transmissions taking place in order to inform the central panel that the manual call point has been activated.

1.15.3.7 Door Magnet Controls

The door magnet control unit shall be able to control the hydraulic action of the door closers installed on the fire doors. The door closers will be supplied and installed by the main contractor and shall be equal or similar to the DORMA EMF range of door closers. A controller or controllers shall be supplied and installed in order to control the fire door magnet outlets of each zone separately. The supply voltage to these points shall be 24 Volt and each door magnetic consumes 3 Watts continuous duty.

The supply to the door magnet units shall be continuous to allow the door closers with normally open solenoids to operate if any disruption of the power supply occurs.

The smoke detector contractor shall connect to the door closer at a control box which will be situated in close proximity to the door.

1.15.3.8 Sounders and Strobes

The sounders and sounder strobe combinations shall comply with BS 5839, Parts 1 and 4. These units will be aesthetically designed with a high sound output and a low current consumption.

The frequency or major frequency in a two-tone alarm shall be between 500 and 1 000HZ.

The sound level for sounders and audible alarms shall be as follows:

Audible indications:	65dB (A) at 1m.
Evacuation sounders:	103 dB (A) at 1m.
Outdoor sirens:	112dB (A) at 1m.

The visual element on the sounder strobe combination unit will have a flash frequency of one second.

The units shall have at least an IP54 rating.

1.15.3.9 Alarm Bells

The bell shall be a 150mm diameter, red, stove enamelled gong. Operation is based on motorized striker movement, capable of a sound output of 95dBm. The current consumption shall be equal to or less than 30mA with a supply voltage of 24VDC.

The sound output frequency shall comply with BS 5839 Part 1: 1988.

The bell shall also have an IP41 rating.

1.15.3.10 Loop Isolators

The loop isolator shall be designed to connect into the loop circuit and monitor the loop for short circuit. In the event of a short circuit occurring the loop isolators on each side of the short circuit are to disconnect and isolate that portion of loop from the system enabling the remainder of the system to function normally.

A light emitting diode (LED) must illuminate when an isolator is in an open condition.

1.15.3.11 Zone Monitor Unit

The zone monitor unit will interface a zone of conventional, non-addressable detectors and call points to the analogue addressable system. This unit will connect to the 2-wire loop. The device shall power the conventional zone from the analogue addressable loop and supervise the zone for short circuit and open circuit by means of an end-of-line resistor.

The device shall report fire alarms and faults to the panel under a single address common for all the conventional detectors. The alarm LED on the detectors will light up in alarm condition. The unit shall have an output to drive a remote LED.

The zone monitor unit shall be available in a flush mount and surface mount version with maximum dimensions 150x90x48 mm.

1.15.3.12 Fire Control Panel

The control panel shall be supplied and installed by the Contractor in the Reception.

The control panel shall house all control units and shall be manufactured of extruded aluminium, giving 20 % spare space for expansion.

The Contractor must liaise with the supplier of the equipment console to ensure a matching, neat and proper control panel and console.

The system shall be functional for 24 hours of the day and operated (controlled) by hand by trained staff.

All controls and lamps shall be accessible on the unit front panel/s. All loose interface equipment, power supplier, etc. shall be neatly installed in the control panel or equipment rack.

Matching blank panels shall be fitted into the spare section of the console to accomplish the requirements stated in this specification.

Plugs and sockets shall be fitted to the rear of the equipment to allow the equipment to be unplugged for maintenance purposes.

Sufficient cable and connecting wire slack shall be allowed for to enable the withdrawal of equipment on site for adjustments without the need to unplug.

This unit shall conform with BS 5839 Part 4 or EN 54-2 and shall be approved by Telkom in the RSA. It shall make provision for at least the following functions:

The control panel shall continuously monitor a number of parameters of the field devices, make decisions and take actions based on the information received.

Sensing devices shall not switch into an alarm state. All decisions shall be taken by the control panels only.

To enable the system to be tailored to suit the protected building and to permit future changes, the alarm management shall be configurable from the control panel via a keypad. This configuration shall be maintained under power failure conditions in non-volatile memory.

The front panel of the control panel shall comprise a keyboard, alpha numeric display, text and indicator LED, etc. The occurrence and location of an event shall be displayed on the screen.

Outputs for communication with devices such as remote text display units, graphic display units, computers, printers and intelligent mimic panels shall be provided where necessary.

The control panel shall be supplied complete with printout facilities. Connections (a printer port and 24 Vdc power connector) for a portable printer shall be required.

The control panel shall further have the facilities to execute the following functions, via potential free 2A rated contacts:

- Transmission of a general fire alarm to the Fire Brigade.
- Monitored switching off of air conditioning equipment in case of a general fire alarm.

The control unit shall be of a high degree of engineering design and of high level of workmanship. The design shall be modular so as to ensure rapid fault finding and replacement of faulty circuit boards or components.

Monitoring of detector circuits shall be such that the following conditions shall be detected and displayed as a "FAULT" condition on the control panel:

- (a) Open circuit line
- (b) Short circuit line

The system shall operate in the "Fail Safe" mode, that is, the presence and functional condition of each and every detector head and signal line shall be proven by a small current flowing continuously through a monitoring circuit.

A bleeper shall be provided on the control panel with the facility to be switched off. A "Fault Alarm" shall operate this local buzzer only and shall not be extended to the alarm bells.

Consecutive alarms shall be stored by the control panel in chronological order and shall have the ability to determine the priority order of alarms by means of repetitive receipt of data from detectors.

A "Fire Alarm" shall operate a local buzzer only and shall not extend to the main alarms in the passages. These alarms shall be activated by a special fool proof switch only after confirmation of a fire condition by the appropriate personnel.

The control panel shall be able to function as a stand-alone unit, together with its own power supplies and shall not be dependent on external control equipment, such as computers, for functioning.

Provision in the form of suitable terminals, connectors, or ports, shall be made on the control panel for the connection of peripheral equipment, such as computers, printers and interface equipment, to ensure that the accumulation of data generated by detectors and the control panel, to be used for future reference, or for the relaying thereof to remote monitor or control equipment.

The transmission of all data shall be via a two-wire system, which shall carry both the supply voltage and the data.

The type of wire or cable used shall be suitable for the speed of data transmission so that signals can be carried over without loss of information or corrupted data. Wiring shall meet the requirements of the detection system manufacturer, which requirements shall be published in a formal wiring specification.

The control panel shall be fully programmable through the keypad on the front of the panel, and through an RS 232 port by using a separate computer or global repeater panel.

It shall be possible to make back-ups of the programmed data onto separate magnetic media by means of an external computer linked to an RS 232 port on the control panel.

Communications with other equipment, such as computers, shall be achieved through RS 232 ports using a fully documented public domain protocol. The protocol documentation shall also be included in the Maintenance Manual so that it will be possible for another party to communicate with the control panel without the approval of the control panel manufacturer.

All communications with other equipment shall be bi-directional, and at least the functions and displays available on the front of the control panel shall be possible through the communications port. Programming of the control panel by means of other equipment is not required (except as described earlier).

The control panel shall be equipped with an alpha numeric display capable of displaying at least 80 characters.

A message of at least 40 characters long per device shall be programmable and displayable on the display.

The display of the following reports/information shall be possible:

- Device information
- List of the devices isolated
- List of devices that need maintenance
- List of the most recent events
- I/O mapping
- Device messages

Each sensing device shall be numbered individually and uniquely to correspond with its address on the control panel.

If a detector head is moved from its base to another base, the address of such a detector shall remain at its original location indicated on the control panel, i.e. the base shall be addressed and not the head.

The address of each device shall be manually set to the desired value.

Addressable devices shall be polled by the control panel and the equipment condition and analogue status shall be read and stored in the control panel.

The varying status of each device shall be assessed by software algorithms and the control panel shall indicate the following conditions:

(i) Analogue Detectors

Detector removed
Incorrect type of Detector
Detector failed
Detector contaminated
Pre-alarm
Fire Alarm
Detector healthy

(ii) Interface to Contacts

Fire Alarm
Interface removed
Interface faulty
Contact wiring open circuit
Contact wiring short circuit
Contacts normal

A printer shall be provided.

The printer shall provide a hard copy of the following:

- Alarms
- Faults
- Maintenance date
- Control panel operations
- Outputs Operated
- Configuration report
- Status report

The printer shall print out the following information for each alarm or signal:

- Type of alarm or fault
- Device type
- Device number
- Zone number
- User message
- Day
- Date
- Time

It shall be possible to set the printer to print out alarms, faults, control panel operations, and outputs operated, either individually or in any combination.

Control panels shall utilize electronic devices specially designed for minimum power usage in both battery and main power supply modes.

Battery charging equipment mounted in the control panel, or elsewhere shall be mounted in such a way that 220 V terminals and wiring and other mains voltages are shielded against accidental contact. All shields shall be marked 220 V.

No 220 V terminals shall be placed directly next to other terminals containing wiring at other voltages.

The power pack of the control panel shall be able to accept an incoming $230 \pm 10\%$ Volt single phase supply and shall be equipped with transformers, rectifiers, inverters, condensers and integrated circuits for the supply of stabilised power to the control panel equipment and detector circuits.

The power supply unit shall be equipped with over voltage protection and spike arrestors to prevent damage to the equipment by lightning or other spikes, or damage due to over voltages.

The battery charger shall be able to deliver the full charging current to discharged batteries, and thereafter the charger shall automatically vary the charging current to the batteries as may be required by battery voltage conditions. Batteries shall not be subjected to overcharging. The battery charger shall be protected against reverse polarity and short circuits on the DC supply side.

The power pack of the control panel shall regulate the supply voltage to detectors so that detectors or bases are operated in their nominal supply voltage range.

Upon loss of mains power, the power supply unit shall automatically revert to battery power, where after the system shall remain fully operational for a period of 24 hours and shall be able to operate the total alarm load for a further period of 1 hour. The unit shall automatically revert back to mains power upon mains power restoration and manual resetting of the unit shall not be necessary.

The power supply shall be equipped with the following indications on the front of the unit:

- | | | | |
|-----|-----------------|---|-----------|
| (a) | "Mains On" | : | green LED |
| (b) | "Charger Fault" | : | amber LED |

Batteries shall be mounted in a separate ventilated padlockable cubicle in such a way that contamination of other equipment cannot take place by utilizing a special plastic container to contain any possible spillage. Any supply fault, charging fault or low battery voltage shall be transmitted to the control panel so that an alarm can be generated. No fuses or switches shall be accessible on the front of the power supply unit without opening the door. Batteries shall be of the sealed lead acid type and the sizes of the batteries to be used shall be indicated on a label in the battery cubicle. Batteries shall be charged to 85% of their capacity within 24 hours.

Wiring terminals shall be clearly marked with a label strip for identification so as to simplify installation and connection of wires on site, during installation. All outgoing and incoming terminals and all other equipment in the control panel, shall be suitable labelled to simplify maintenance and installation and all panel mounted equipment shall likewise be labelled. Outgoing and incoming power and field wiring shall be individually and correspondingly, numbered at each point of termination.

The control panel shall have knock-outs in the bottom plate thereof to terminate conduit for all power cabling and knock-outs in the top plate thereof, to terminate conduit for signal and other electronic cabling or wiring. Holes drilled on site for this purpose will not be acceptable.

All identification labels, as well as wire terminal numbers shall be clearly shown on all wiring diagrams in the maintenance manual.

It shall be possible to silence the audible alarms without influencing the visual alarms or alarm transmissions to the Fire Brigade.

Two (2) spare fuses shall be provided.

1.15.3.12 Fire Panel Operation

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

Level 1: Control Key

The control key shall be used to enable or disable the key board and control keys of the panel.

Level 2: Access Codes

Access codes shall be used to prevent unauthorised entry into the programming menus of the panel. Each menu shall be able to have 2 different levels of access.

Level 3: Door Lock

The panel door lock shall be used to prevent unauthorised entry into the cabinet.

Level 4: Non-Volatile Memory Switch

The non-volatile memory switch shall prevent any unauthorised or accidental changes being made to the system configuration data.

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

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

Should any part of the system be isolated or placed in a maintenance mode then a LED on the front of the panel must illuminate to indicate the systems abnormal status. This condition must also be indicated on the LCD display. The normal operation of all other devices shall not be affected in this state.

1.15.3.13 Self-Monitoring

The control panel shall be designed and programmed to perform extensive automatic self monitoring. If the control panel detects a fault, it shall result in a fault indication being given by means of a common fault amber LED.

The following shall be continuously monitored by each fire panel:

- * 24 V power supply fault (external supply)
- * Fire brigade / evacuation short circuit

- * Alarm bell open circuit
- * Fire Brigade short circuit
- * Alarm Bell short circuit
- * Power failure
- * Watchdog time-out
- * Low battery
- * No battery connected
- * Tamper switch
- * No printer
- * Memory lock unlock
- * Event buffer full
- * No communication
- * Earth fault
- * Battery over-voltage
- * R.A.M memory check
- * EPROM memory check

1.15.3.14 Fire Operation

Any fire alarm will cause the following actions to occur immediately:

- * The LCD to light up and display the following information:
 - type of alarm
 - loop number
 - zone number
 - sensor address
 - type of sensor
 - event number
 - status
 - number of alarms
 - time and date
 - 2 lines x 40 characters of user programmable text
- * The common fire indicator and appropriate zone fire indicator will illuminate
- * The LED on the affected detector(s) will operate
- * The event will be logged in memory
- * Programmed relays will be triggered
- * The fire alarm will override any fault condition that might be present on the display
- * Bell & fire brigade/evacuation outputs will become active according to the immediate or delay parameters set
- * Sounders and bells will continue to operate (continuous tone) until silenced by inserting the control key and pushing the silence alarm button
- * If the bells and fire brigade have been silenced they will become active again for any new fire alarm
- * Sounder circuit controllers will be sounded as programmed
- * Messages will be sent to the configured data ports and/or printer

- * Coincidence, area and adjacent area devices will be operated as programmed
- * A red LED will be lit on the different mimic panels indicating the floor or detector which are in the active fire state.

1.15.3.15 Fault Operation

A fault warning will cause the following actions to occur immediately:

- * The LCD to light up and display the following information:
 - type of alarm
 - loop number
 - zone number
 - sensor address
 - type of sensor
 - event number
 - status
 - number of alarms
 - time and date
 - 2 lines x 40 characters of user programmable text
- * The system fault and appropriate zone fault indicator (LED) will illuminate
- * The "general fault" relay will activate
- * The panel buzzer will sound intermittently
- * Inputs/outputs configured for fault will be operated, messages will be sent to the configurable repeater panels mimic drivers and graphics.
- * The system fault and appropriate zone fault indicator (LED) will illuminate
- * The "general fault" relay will activate
- * The panel buzzer will sound intermittently
- * An amber LED shall light up on the different mimic panels to indicate the position of the faulty detector.

Note: The removal of any unit will provide a communication fault signal, which cannot be reset until the appropriate unit has been replaced. The removal shall not restrict the normal operation of the rest of the loop.

1.15.3.16 Maintenance Alarm

Should a detector become contaminated, a maintenance alarm will be indicated and logged as follows:

- * "Maintenance Alarm" LED will illuminate
- * The LCD to light up and display the following information:
 - type of alarm
 - loop number

- zone number
 - sensor address
 - type of sensor
 - event number
 - status
 - number of alarms
 - time and date
 - 40 characters of user programmable text
- * The panel buzzer will sound intermittently
 - * An amber LED shall light up on the different mimic panels to indicate the position of the faulty detector.

1.15.3.17 Electronic Dialling Device

The unit shall be surface mounted next to the fire detection control panel.

This two-in-one alarm control unit shall be as supplied by "SESCO" cat. no. 4195 or similar and must consist of the following features and benefits:

- (a) High quality keypad control unit.
- (b) Lightning protected.
- (c) Selectable entry/exit time delay or instant arming.
- (d) Four (4) N/O or N/C zones and a N/O or N/C panic zone.
- (e) Panic, burglary and power trouble facilities to report to one or more of eight pre-select telephone numbers.
- (f) High quality, solid state devices to ensure voice clarity.
- (g) Instant programming via units own keypad.
- (h) 100% reliability.
- (i) Adjustable siren output time from 30 seconds to \pm five minutes.
- (j) DTMF or pulse dialling with selectable "dial-tone detect".
- (k) Test facility.
- (l) Selectable siren or telephone activation.
- (m) Selectable siren or buzzer annunciation.
- (n) Play-back facility to listen to recorded messages.
- (o) 4K7 end-of-line resistors on key switch, panic and burglary zones.

- (p) 2K2 end-of-line resistors on the light trigger zone.

In the case of an alarm (fire, power failure or panic) this unit shall automatically, by using the telephone line dial up to eight pre-select telephone numbers, (e.g. Fire Brigade, Police, etc.) informing the dialled occupant of the relevant situation.

Inputs to this device shall be:

- (a) Fire alarm from the fire alarm control panel.

1.15.4 WIRING AND ELECTRICAL REQUIREMENTS FOR DETECTORS

The Contractor must take note that it is a specific requirement that only fire proof multicore stranded wires and cables shall be used where wiring is done outside of steel conduit.

All wires and circuits shall be clearly identified by either using colour coded cable or plastic label tags.

Wiring shall be arranged in a return loop (ring), in such a manner that, in the event of an open circuit or a short occurring on the line, the control panel communicates with the detectors from both sides of the loop.

The arrangement shall be such that during an open or short circuit no more than 50% of any zone shall be deactivated. To enable this, line isolators shall be provided on the line on each side of each zone.

Cable ends shall be terminated in approved terminal blocks as supplied by MS², Klippon, Waco or other approved type. **"Cheese blocks" are not acceptable.** In the distribution board the Contractor shall use terminal blocks that are specially designed for this function and in which the terminals are easily accessible, clearly labelled, well supported and easy to wire, using a spring mechanism to grip the wire.

The wires of each circuit shall be strapped together and clearly labelled in all wire ways.

Where coloured wires are used, the wiring shall be done in such a way that the same colour is used throughout for a specific circuit.

Identification shall be such that any circuit can be clearly identified and traced from the line diagrams.

The Contractor shall determine the various wire sizes to ensure that the voltage drop in any circuit shall not exceed 2 V under alarm conditions. These requirements also include the alarm circuits.

Cables shall be terminated on each detector base or break glass unit. The wiring shall be arranged in the "loop" method and no "T-offs" or joints shall be permitted.

All draw boxes shall be clearly indicated on the "As Built" drawings.

The insulation resistance of all circuits must be tested individually with a suitable insulation tester at 50 V and shall not be less than 1 Megohm with detector heads plugged in.

1.15.4.1 **The Communication Circuit**

Communication to the field devices of the entire detection system will be by means of a 2-wire circuit, which will simultaneously be used for power. The communication system shall be able to handle class A and class B loop arrangements. Spurs and branches shall be allowed in both cases.

All communication shall be under the control of the fire panel, which shall poll each device sequentially in order to obtain the latest status of a device. Even when a detector is in an alarm state, the panel shall still be able to determine the latest status of the detector. There shall be no limit to the number of devices, which may be in alarm simultaneously.

The control panel shall poll all devices attached to the system within 5 (five) seconds. However, should a fire or fault condition occur, the appropriate devices shall inform the control panel of their status within 1 (one) second. The panel shall then make decisions based upon the information received.

The addresses of all devices shall be uniquely identifiable by the control panel. All detector addresses shall reside in the mounting bases, which shall be electronics free. The removal of an addressable device from the loop shall not affect the operation of the remaining devices in the loop. The control panel shall be able to identify the type of alarm device located at each address in the loop.

1.15.4.2 **Conduit and Conduit Accessories**

The Contractor will be responsible for the supply and installation of all conduits and conduit accessories.

Conduit and conduit accessories shall be of the Bossil type and shall be cast in, or built into the building structure. Where conduit and conduit accessories are surface mounted on building structures, all work shall be done neatly, parallel to the building structure and in straight lines. Conduit shall be saddled at 1m centres with spacer saddles. M4 machine screws shall be used for fixing of spacer saddles onto steelwork. Suitable holes shall be drilled and tapped in the steel work.

All quality of materials and methods of installation of steel conduit and conduit accessories shall comply with SANS 10142.

Conduit installations shall be done in such a way that detector circuit wiring can be done without any interruption and without T-joints.

Round draw boxes for detectors shall be mounted against the ceiling in the case of false ceilings or ceilings of pitched roof buildings and detector bases shall be mounted against boxes so that no open wiring is visible anywhere in a conduit and wiring system.

No sprague tubing or PVC conduits shall be used in detector wiring system. Only flexible conduit that is not of the spiral type may be used in special applications.

1.15.5 INSTALLATION

1.15.5.1 **Control panel**

Mechanical design

The control panels shall be housed in a cabinet designed for mounting directly to a vertical surface. The back box and door shall be constructed with provisions for electrical conduit connections. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators.

The control units shall be modular in structure for ease of installation, maintenance and future expansion.

System Capacity

The control panel shall provide and be capable of expansion to the following capacities:

Addressable loops - 12

Devices per loop - 127

Addressable devices per loop - 127

Total addressable devices or control modules - 508

The control panel shall be wall-mounted as indicated on the drawings. Cabling between the control panel and auxiliary equipment shall be neat and tidy in conduit channels supplied under this contract.

A 40 column impact printer shall be provided at the main fire panel.

1.15.5.2 **Sensors and Monitor**

The panel shall support at least the following types of sensors and monitors:

Fire Sensors

- * Optical smoke
- * Heat
- * Manual call point (indoor and waterproof)

Monitoring Controllers

- * Zone monitoring unit; used to interface a conventional zone of detectors or an aspiration system to the analogue addressable system
- * Manual call point monitor; used to interface conventional break glass units to the analogue addressable system
- * Control unit monitor; monitors voltage free fire and fault contacts, reporting their status to the analogue addressable system
- * Isolator; for short circuit protection
- * Sounder circuit controller; used to operate sounders in a zone

Input/Output Devices

- * Single channel I/O unit; one input and one output
- * Triple channel I/O unit; three inputs and three outputs
- * Switch monitor unit; for monitoring normally open or normally closed contacts

1.15.5.3 **Detectors**

Detectors shall be ceiling mounted where possible and break glass units at 1400mm above finished floor level. The onus is on the Contractor to contact the Engineer for a ruling whenever there is any uncertainty regarding the position of installation of any piece of equipment. Failure to comply with this specification might require later movement of such equipment at the Contractor's expense.

1.15.5.4 **Cables and Wiring**

Installation shall be in strict compliance with the manufacturer's recommendations. The manufacturer must be consulted for all wiring diagrams, schematics, sizes, outlets, etc before installing the equipment and wiring.

All equipment shall be held firmly in place. Fastening and supports shall be adequate to support the loads with a safety factor of five.

The fire alarm control panel shall be connected to a separate dedicated un-interrupted power supply branch circuit of maximum 20 amperes.

This circuit shall be labelled as "Fire Alarm" and supplied under this contract as a dedicated plug or isolator for each fire panel, global repeater panel or mimic panel.

All wiring shall be completely supervised. In the event of a primary failure, disconnected standby battery, disarrangement of any components, or any open circuits in the system, an audible and visual trouble signal will be activated until the system is restored to normal.

Zones shall be clearly indicated on the fire alarm control and mimic panel. The names and the position of the zones shall be co-ordinated with the engineer and client and shall meet with their approval.

Air conditioning system(s) shall be indicated on a separate zone.

Open cable shall not be allowed above ceilings, in attic's and in other areas allowing surface wiring. All wiring shall be done in conduit.

Cable shall be the type " listed for the use" as specified under National Electrical Codes, NEC article 760-30 (bell wire, intercom or telephone wire are not approved).

Enclosed cable installed in 20 mm diameter conduit shall be of 0,5 to 0,8 mm² screened (shield) "Belden" or equivalent type.

Open cable installed on the surface in open roof (void) spaces shall be of 0,5 to 0,8 mm² "Perilli" or "Alpha Pyron" special fire cable.

All cable shall be installed as per NEC article 760.

Leave 150 mm wire tails at each device box and 1 m wire tails at the fire alarm control panel.

Cable for the initiating devices (manual stations, heat detectors, smoke detectors, etc) shall be looped. Cable shall be installed from the monitor module to the first device, then to each succeeding device within each address line and back to the monitor module.

Cable shield continuity must be maintained and connected to earth ground only at the control panel. Intelligent detector wiring must not be routed power wiring, 240 V AC power wiring or other high current circuits.

Cable for the control of the air conditioning units must be installed in the cable duct air-conditioning plant room between the control room and the -2 basement level.

The air conditioning units of the entire complex must be shut down should a fire alarm occur. The fire alarm Contractor shall allow in his tender for one control cable and the control panels as indicated on the drawings. The control wiring from the air conditioning control panel to the air conditioning unit shall be done under this contract.

The system shall be wired such that the air conditioning system shall shut-down after detection of a fire by a detector.

Steel conduit or channels shall be installed under this contract for wiring to the break glass unit as indicated on the electrical drawings.

The surface fire cable shall be held in place at the device by means of two special cable glands fixed to a 65mm diameter draw box. The wiring/cable shall be installed as shown on detail sketches.

The surface wiring/cable shall be held in place at the device box, by means of gripper glands. The cable must be stapled or strapped per NEC or at 1 m maximum spacing.

Cables must be separated, minimum 50 mm from any open conductors of light, power and shall not be placed in any outlet or draw box or containing these conductors, as per NEC article 760-29.

All splices or connections shall be made within approved junction boxes and with approved fittings. Boxes shall be red and/or labelled "Fire Alarm System" or other approved markings.

1.15.5.5 **Detection Lines**

Detection lines may have a capacity of detectors or devices as decided upon by the manufacturer, but this capacity shall not exceed 127 devices per line.

These detectors/elements shall be freely distributable over any one of the individual alarm zones.

Zones must be clearly defined and quick and precise identification of a fire must be possible.

Each line shall be capable of all the self monitoring functions.

The control Unit with its mimic panel shall be utilised to indicate the exact position of triggered detectors/elements in any line.

A triggered detector/element shall not cause any other detectors on the line to seize monitoring.

The Central Control Unit (Global repeater panel) shall be capable of switching off air conditioning units in the case of a fire alarm.

It shall be possible to control the equipment, in the specific zone where a fire has been detected.

Any detector when triggered, shall be capable of causing specific control functions.

Any individual zone or detector in an alarm line shall be capable of being isolated without affecting the operation of the remaining zones or detectors in the line and without raising the fire alarm. However during this condition an isolation indication per zone, shall be displayed on the Control Unit.

1.15.5.6 **RS 485 Cable for Networking between Control Panels**

The maximum cable length is determined by three factors:

1. The data rate of the network
2. The capacitance/Km of the cable (both core to core and core to shield)
3. The loop resistance (core size) of the cable.

The maximum recommended length using Beldin 9841 cable or equivalent is 1500m (1.5 km).

Specification: Single twisted pair with screen and earth drain

Capacitance	:	41.7 pF/m core to core
	:	75 pF/m each core to screen
Characteristic Impedance	:	120 Ohm

Screens of the RS 485 line must be earthed at one point only. Terminals are provided on network components to terminate and to continue the screen of the cable.

The RS 485 cable shall only be used for the connection between the fire panels.

1.15.6 PROGRAMMING OF CONTROL PANELS

To allow programming, the operator shall have to:

- * Enable the control key
- * Open the panel
- * Switch off the non-volatile memory protection switch
- * Put in the programming code

Programming will be possible from the keypad at the front of the panel or by downloading it from a PC. All programming will be menu driven. The programming will allow for at least the following functions.

1.15.6.1 Programming Output Relays

The following programming options shall be available:

- * Allocation of a relay to any loop(s)
- * Allocation of a relay to any zone(s)
- * Allocation of a relay to coincidence in zone (b); if coincidence is selected, the relay may not accept any other lone or loop function
- * Select activation delay per relay, for each relay. An individual delay from 0-600 seconds will be programmable
- * View relay status
- * Changing of relay status from normally open to normally closed

1.15.6.2 Programming Sensors

The following programming options shall be available:

- * Viewing full status of all addressable devices
- * Enabling or disabling of loop(s)
- * Enabling or disabling of zone(s)
- * Enabling tents to operate in coincidence mode

- * Programming of sensors:
 - The type of sensor (Optical, ionisation. heat) will be set automatically in power-up stage or the panel
 - The monitoring units will be selectable by toggling through a monitor (I/O) menu
 - For each sensor it will be possible to programme:
 - * Status enabled/disabled
 - * The zone it belongs to
 - * The sector where it is located (ceiling. room or void)
 - * The detection level (level 1 (default) level 2, 3 or 4); each level will have a fixed pre-alarm and alarm calibration
 - * Selecting rate of rise operation for the heat sensors

1.15.6.3 **Programming I/O**

It will be possible to programme a minimum of 400 input or output blocks. Each input/output block will be associated with an input/output device. Different input/output blocks can refer to the same output device.

It shall be possible to freely programme I/O units without zone or loop restriction.

1.15.6.4 **Output Programming**

- * It will be possible to switch (ON/OFF or Impulse) an output by:
 - Any input or any loop
 - Any zone on any loop in fire or fault or coincidence mode
 - Any sensor on any loop
- * It will be possible to delay the activation of any output up to a maximum of 255 seconds on an individual basis.
- * The outputs can be programmed to follow silence alarm or reset on an individual basis.

1.15.6.5 **Input programming**

- * It will be possible for any input to trip:
 - Any output on any loop
 - Any lone on any loop in fire or fault mode
 - Any lone LED in standard or inverse way
 - Any of the 16 programmable relays
- * It will be possible to programme an individual input delay up to a maximum of 60 seconds.

1.15.6.6 **Upload/Download**

It will be possible to programme all the above also from a PC by downloading the information to the panel. This way, it will allow the installer/user to have a copy of the complete system's programme on a compact disk.

One way of programming will not exclude the other.

It will be possible at all times to upload the stored programme to a PC in order to maintain updates.

1.15.7 PREVENTING FALSE ALARMS

It will be possible to put any zone(s) in coincidence mode. Coincidence mode will allow bells, fire brigade/evacuation, relays and I/Os to only activate whenever at least 2 (two) detectors have alarmed within the selected zone(s).

Each call point shall be programmable as either a warning or an alarm (evacuation) call point. A warning call point will respect the fire brigade/evacuation delay; an alarm call point will ignore this delay.

1.15.8 ZONE EXTENSIONS

1.15.8.1 Fireman's Panel

The open collector driver will come as a PC board to accommodate mimic panels. The outputs will drive at least 10mA.

The repeater will have the following outputs:

- * Either 8, 16, 32 or 64 freely programmable open collector outputs
- * Alarm
- * General fault
- * In service / processor running
- * Communication failure

This board will have inputs for local silence buzzer and LED test.

1.15.8.2 Mimic Panels

The mimic is to be situated in the Reception area. It is to be an A1 sized steel cabinet with a tiled mimic depicting a section through the building. It shall indicate fire conditions present on each floor or part there-of. The indication shall be by means of two dual filament LEDs per area indicated. They shall be green under normal condition and change to red, indicating fire condition. Each fire control panel shall be indicated on this mimic, and have an amber LED associated with it. Should there be any fault condition on a panel, the amber LED shall be lit. Any

change of state with any LED on the mimic must raise an audible alarm.

In addition, the mimic is to house and display zone select controls for the PA evacuation system and a hand held microphone. Controls to over-ride the lift returns pressurisation fans and air-conditioning shut down shall also be present and functional on this mimic. To allow visual control of the three networked fire control panels there shall be an LCD node, connected to the nearest fire panel using 1 pair copper cable (Balden 9851). It shall be possible to view each panel from this LCD node. The mimic is to communicate to the LCD node using a 4-wire current loop. All relevant signals are to be acquired from the LCD node. These functions shall not appear on the copy of the mimic in the security room.

Drawings accompanying will depict the fascia of the mimic, as well as the internal electronics and necessary cable connections.

1.15.9 CONTROLLERS, MONITORS AND I/O UNITS

1.15.9.1 Manual Call Point Monitor

The manual call point monitor shall be able to monitor a zone comprising up to 20 conventional manual call points and shall have a priority interrupt facility. In other respects the manual call point monitor shall comply with the requirements for zone monitoring units.

1.15.9.2 Switch Monitoring Device

A switch monitoring device shall be addressable and be designed to monitor a normally open or normally closed switch contact. The switch shall be fully floating and low resistance when closed.

Eight wiring terminals shall be provided, 4 for connection of the incoming and outgoing ring circuit, two for a remote LED drive and two for an external switch connection.

1.15.9.3 Input/Output Devices

Input/output devices shall be designed to collect and transmit status information from external devices via the input bits, and operate relays as instructed by the output bits from the control information.

For relay operation the operation instruction shall be continually renewed each time the control unit addresses the device.

Output relay rating shall be 5A, 250VA.

LEDs shall be fitted to the units, which are turned on for input high or relay energised.

1.15.9.4 **Single Channel Input/Output Unit**

A single Channel input/output unit shall have a single logic input for reporting the status of an external device. One fully floating relay changeover contact switchable by the control unit shall also be provided. The relay shall be operated when the control equipment sets output bit 0 to logic high in two or more consecutive addressing of the unit.

Twelve wiring terminals shall be provided:

- 4 for the connection of the incoming and outgoing ring circuit
- 2 each for supply positive and negative, the relay pole normally open and normally closed contacts, and one for signal level.

1.15.9.5 **Gas Discharge Control Units**

The gas control unit shall be designed to interface a gas protected area to the analogue addressable control panel. The unit shall provide evacuate facilities and shall control the safe discharge of gas.

The self-contained unit shall have key switches for automatic or manual selection, as well as an isolate switch for maintenance and resetting the system after activation. Indicating dual LED's are to be provided for Auto, Manual, Isolate, Gas Discharge and Fault. A buzzer shall be sounded for fault warning. A lamp test push button shall also be provided. A dual-action (lift flap break glass) manual gas release device is to be provided on the gas control unit.

Supervised relay contacts are to be provided for the Bell, Siren, Evacuate Sign and Gas Discharge. These contacts shall be monitored for short circuit, open circuit and fuse failure. The door interlock mode shall provide a warning buzzer when the door is locked and the gas control unit is in manual mode, or when the door is unlocked and the gas control unit is in the automatic mode.

Internal LEDs shall be provided for the various fault conditions to allow for quick maintenance.

Should the protected area have a second entrance, a remote gas unit shall be provided.

The remote gas unit shall provide an indication of the status of the main gas control unit by means of dual LEDs as well as a manual call point discharge facility.

A gas status unit shall be provided to indicate the status of the gas control unit. Dual LED's provide indication for Auto, Manual, Isolate, Gas Discharge and Fault.

1.15.10 **SOFTWARE CONTROL**

In order to ensure the reliability of the system, the following requirements for software design shall apply:

- The software shall have a modular structure
- Measures shall be included in the program to prevent the occurrence of a

deadlock in the system

- The execution of the program shall be monitored
- The memory contents containing program and configuration data shall be checked automatically at intervals not exceeding 1 hour.

1.15.10.1 **Operating Programmes**

All executable code and data shall be held in memory, which is capable of continuous, reliable, maintenance free operation, for a period of at least 10 years. The program shall be held in non-volatile memory, which can only be written to at access level 4.

1.15.10.2 **Configuration Data**

The site-specific data shall be protected against power loss by a back-up energy source, which can only be separated from the memory at access level 4. The back-up battery shall be capable of maintaining the memory contents for at least 5 years.

1.15.10.3 **Maintenance Software**

Maintenance of the system shall be able to be performed via a computer/modem connection to the network. All control panels on the network shall be able to be accessed remotely via the computer. Entry into the system shall be password protected and it shall be impossible to change any site configurable data without operator intervention at the respective control panel.

It shall be possible, once connected to the system, to:

1. Emulate any panel as if the operator were standing at the panel;
2. Upload/Download the site configuration;
3. Selectively retrieve all or parts of the event buffer.

The system shall also operate in 'central station' mode whereby the panels may dial to the local fire brigade for fires and to a different station for faults and conditions. The telephone numbers for the central stations must be configured in the panel. It shall be possible to dial different stations for fires and faults.

1.15.11 **CONTROL SWITCH OPERATION**

1.15.11.1 **Acknowledge Switch**

Activation of the control panel acknowledge switch in response to a single new trouble or alarm condition the system alarm or trouble LEDs from flashing to steady-on. If additional new alarm or trouble conditions exist in the system, activation of this switch shall advance the display to the next alarm or trouble condition that exists, and shall not silence the local audible device or change the LED's to steady until all new conditions have been so acknowledged. New alarm conditions shall always be displayed before new trouble conditions. Occurrence

of a new alarm or trouble condition shall cause the panel to "resound" and the sequences described above shall repeat.

1.15.11.2 **Signal Silence Switch**

Activation of the signal silence switch shall cause all appropriate indicating appliances and relays to return to the normal condition after an alarm condition. The selection of indicating circuits and relays silenced by this switch shall be fully programmable and changeable in the field.

1.15.11.3 **System Reset Switch**

Activation of the system reset switch shall cause all electronically-latched initiating devices or zones, as well as all associated output devices and circuits, to return to the normal state. If alarm conditions exist in the system after the system reset switch activation, the system shall then resound the alarm.

1.15.11.4 **System Test Switch**

Activation of the system test switch shall initiate an automatic test of all intelligent detectors in the system. Such test shall activate the electronics in each intelligent device, simulating an alarm condition. A report summarising the results of this test shall be displayed automatically on the front panel.

1.15.11.5 **Lamp Test**

Activation of the lamp test switch shall turn on all LED indicators, LCD display and local sounder and then return to the previous condition.

1.15.11.6 **Automatic Door Test**

The system shall include a special automatic detector test, which permits a serviceman to test all intelligent detectors from the main control panel.

1.15.11.7 **Watch-dog Timers Test**

The system shall include independent "Watch-Dog" timers to detect and report failure of any microprocessor circuit, memory, or software.

1.15.11.8 **Programming**

The system shall be programmable, configurable and expandable in the field without the need for special tools or PROM programmers and shall not require replacement of memory IC's. All programming may be accomplished through the standard control panel keyboard. All programs shall be stored in non-volatile memory.

The programming function shall be entered with a special password that may be selected when the system is installed. The password may be changed in the field to a new value at any time by entering the old password and requesting a password change.

1.16. **TESTING AND COMMISSIONING**

Although this specification does not necessarily cover every detail of small specialized items, it is a requirement that the complete installation complies with the highest standards of engineering and design practice.

The testing shall be done to the satisfaction of the Engineer in the presence of the Engineer and the Department.

The test shall include the checking of the operation of all the detectors and the tripping of all electronic devices. The complete alarm function with the time delay shall be demonstrated.

The contractor shall supply all equipment needed for the testing of the installation, including a suitable smoke generator.

It shall be possible to put a zone in test mode. The zone in test mode will flash its fault LED and the general "test" LED. All outputs, relays, bells and fire brigade/evacuation will be switched off for this zone. Alarms or faults from other devices or zones will be handled in the normal way. While testing the detector, the panel will light up the detector's alarm LED when reaching the alarm level and reset it automatically afterwards. The printer will confirm this alarm by providing a "test alarm" printout as proof. In this way, maintenance can be performed by a single engineer. The panel will prevent leaving the test mode as long as any sensor is still in alarm.

It will be possible to perform an "electronic test" of all sensors. The "electronic test" will have to force sensors into alarm level. Sensors not able to reach the currently selected alarm level in test condition will report a maintenance alarm.

1.17. **FIRE BRIGADE SIGNALLING FACILITIES**

The transmitting equipment, for the transmission of a general fire alarm to the local Fire Brigade, shall form an integral part of the fire control panel. The transmitting equipment shall be fully compatible with the receiving equipment already installed at the Fire Brigade. Any facilities necessary to accomplish this compatibility shall be included in the transmitting equipment.

The output to the Fire Brigade shall be a monitored output.

The equipment shall include the following:

- Talk facility
- Fire signalling push button
- Ambulance signalling push button
- Automatic fire signal
- Test facility

1.18. PROTECTION OF EQUIPMENT

The electronic equipment under this contract shall be completely protected against electrical surges, voltage peaks and other electrical Newark differences.

It shall also be protected against lightning. Lightning protection shall be done on supplies to the different components of the electronic board associated with that component where applicable.

Special attention shall be given to the proper connecting and earthing of the system.

1.19. SAMPLES

Any samples required by the Department shall be supplied on request after 7 days. Not doing so may disqualify the tender.

1.20. KEYS

All keys to the system, such as doors, panel keys, switch keys and keys for locks shall be marked permanently with a key ring and be handed over with a certificate of the key schedule to a responsible person. This shall be done in writing with a stamp and the approval of the Engineer/Department.

1.21. STATUTORY AND REGULATORY REQUIREMENTS

The installations shall be erected, commissioned and maintained in compliance with the regulations as specified in SANS 10139.

In addition, the Contractor shall exempt the Employer from all losses, costs or expenditures that may arise as a result of the Contractor's negligence to comply with the requirements of the regulations enumerated in this Clause.

It shall be assumed that the Contractor is conversant with the abovementioned requirements. Should any requirement, by-law or regulation, which contradicts the requirements of this Document, apply or become applicable during erection of the installation, such requirement, by-law or regulation shall overrule this document and the Contractor shall immediately inform the Engineer of such a contradiction.

Under no circumstances shall the Contractor carry out any variations to the installations in terms of such contradictions without obtaining the written permission to do so from the Engineer.

2. DATA AND TELEPHONE CABLING INSTALLATION

2.1 TELEPHONE INSTALLATION

The Contractor shall allow for the complete installation of all conduits, outlet boxes, Telkom Distribution boards, sleeve pipes, etc., required for the telephone system as shown on the drawings.

The sizes of all telephone conduits are indicated on the drawings and must be installed in the floor slab. Galvanized steel draw-wires shall be installed in all conduits.

End boxes must consist of a 50 mm x 100mm outlet box fitted with suitable blank cover plates, flush mounted at a height as specified above floor level.

Where Power Skirting is installed, the Contractor shall ensure that adequate conduit link provisions are installed, for the number of Telephone Outlets on Power Skirting, between the Local Telephone Distribution Board and the Power Skirting as indicated on the drawings.

The Main Telkom Distribution Board shall consist of a 150mm deep x 600mm x 600mm metal box and hinged door with a 20mm thick wooden backboard. The TELKOM Sub-Distribution Boards shall consist of 150mm deep x 300mm x 300mm metal box and hinged door with 20mm thick wooden backboard. The boards shall be flush mounted with architrave, installed at 600mm above the floor.

2.2 DATA INSTALLATION

The Contractor shall allow for the complete installation of all conduits, outlet boxes, sleeve pipes, etc., required for the Data cabling as shown on the drawings.

The sizes of all data conduits are indicated on the drawings and must be installed in the floor slab. Galvanized steel draw-wires shall be installed in all conduits.

End boxes must consist of a 50 mm x 100mm outlet box fitted with suitable blank cover plates, flush mounted at a height as specified above floor level.

Where Power Skirting is installed, the Contractor shall ensure that adequate conduit link provisions are installed, for the number of Data Outlets on Power Skirting, between the Local Data Router Equipment and the Power Skirting as indicated on the drawings.

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PART 3: SPECIAL FACILITIES AND EQUIPMENT