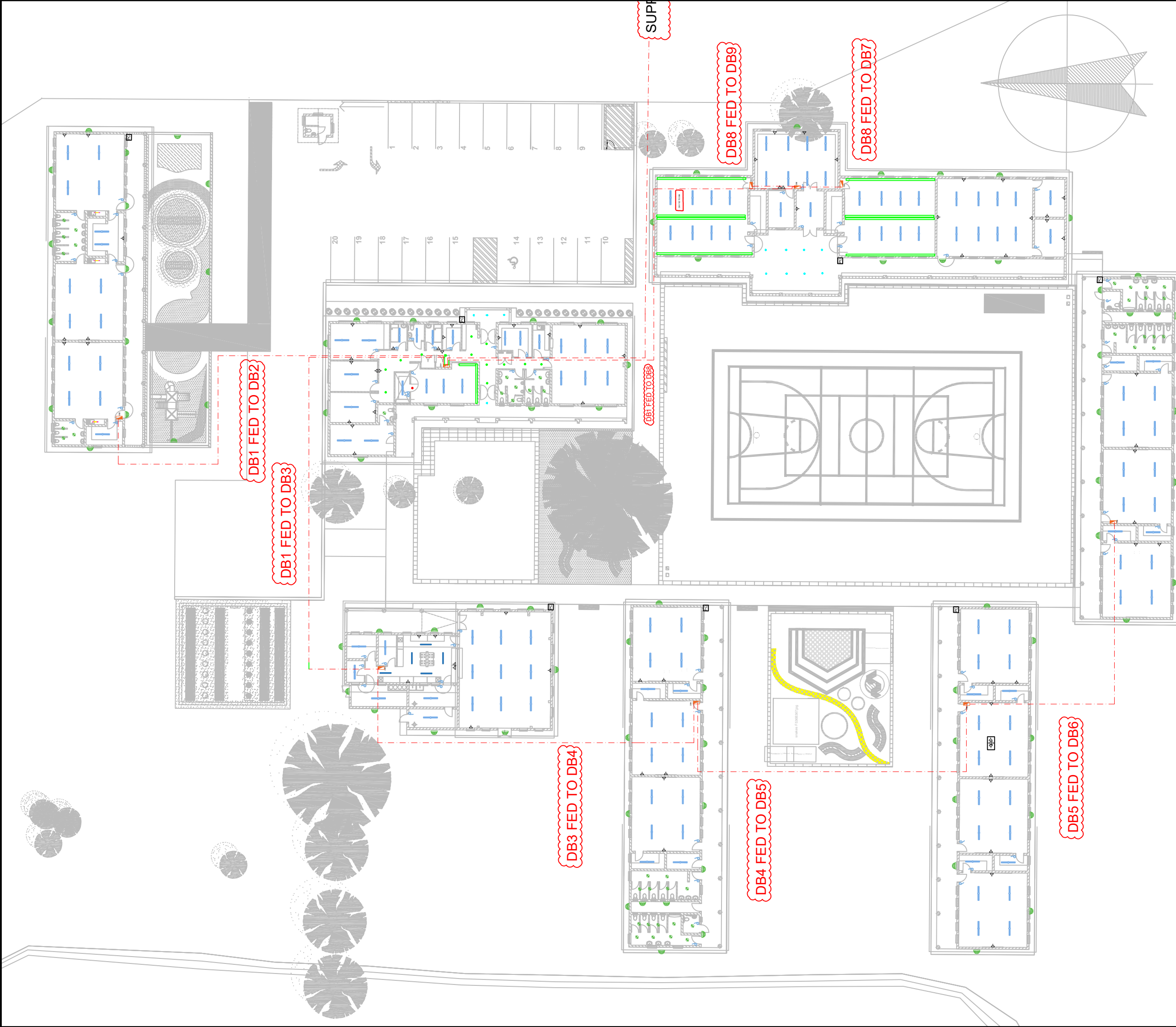


## Annexure E

### ELECTRICAL SPECIFICATION



LEGEND	
(EQUIVALENTS TO BE APPROVED BY ENGINEER)	
	16A 3-PIN SWITCHED DSO-USB-CRABTREE
	2 TIER PVC POWER SKIRTING - PLUG POINT EVERY 1.5 METERS AND RJ45
	10A - SINGLE POLE SWITCH
	LIGHTING FIXTURE
	LIGHTING FIXTURE
	LIGHTING FIXTURE
	LIGHTING FIXTURE
	LIGHTING FIXTURE
	DB POSITION
	DB'S TO HAVE 20% SPARE CAPACITY
	PC
	PHOTO CELL-(DAY/NIGHT SWITCH) - 5A BYPASS SWITCH
	LIGHTING FIXTURE
	LIGHTING FIXTURE

NOTES	
DRAWING MUST BE REFERENCED AGAINST ALL SPECIFICATIONS	
DRAWING MUST BE REFERENCED AGAINST ARCHITECTURAL DRAWINGS	
ALL EQUIPMENT TO BE SABS APPROVED AND HAVE RELEVANT GUARANTEES	
ALL EQUIPMENT TO HAVE SPECIFICATIONS SHEETS AS REQUIRED FOR CLOSE OUT	
ALL EQUIPMENT POSITIONING TO BE FINALIZED ON SITE	
ROUTING INFRASTRUCTURE AND BUILDERS WORK NOT INCLUDED	
ALL SURFACE MOUNTED AND EXTERNAL RETICULATION OF 2.5mm.sq CABLE AND LOWER TO BE INSTALLED IN BOSAL CONDUIT	
5A PLUGS POINTS TO BE INSTALLED FOR LED LIGHTING	

CLIENT			
DEVELOPMENT BANK OF SOUTHERN AFRICA FOR FSDoE			
IMPLEMENTING AGENT			
DEVELOPMENT BANK OF SOUTHERN AFRICA			
1258 LEVER ROAD, HEADWAY HILL, MIDRAND 1685			
TEL: 011 313 3500			
SIGN OFF REGISTER			
Organisation	Name	Signature	Date

CONSULTANT:	
ISENZKO ENGINEERING	
TELEFAX : 031 562 0291	
E-MAIL : isenzko@telkomsa.net	

DISCIPLINE	ELECTRICAL
SERVICE	NEW BUILD

DRAWING TITLE	
SMALL POWER, LIGHTING & DB LAYOUT	

SCALE	DRAWN	DATE	CHECKED
NTS	D.G	SEP 2022	V.H
DRAWING TITLE	LAST REVISION		
WESTERN HOLDING PRIMARY SCHOOL	000		
SMALL POWER, LIGHTING & DB	DRAWING No.		
PRELIMINARY POSITIONING	WHPS-SP-EL-DB-REV00A		

## DETAILED ELECTRICAL SPECIFICATION

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## **DETAILED ELECTRICAL SPECIFICATION**

### **ELECTRICAL INSTALLATION**

#### **1. COMPLIANCE WITH REGULATIONS**

The entire installation shall be carried out in accordance with the latest revision and amendments of the following:

- The Code of Practice for the Wiring of Premises as issued by the South African Bureau of Standards – SANS 10142-1, Edition 1: 2001, as amended.
- The Occupational Health and Safety Act No 85 of 1993.
- SANS 204
- The Basic Conditions of Employment Act No 3 of 1983.
- The Municipal By-laws and any special requirements of the Supply Authorities of the area and district concerned.
- The Local Fire Office Regulations.
- Telkom Regulations.
- The applicable SANS Specifications or the BS Specifications where no SANS Specifications exist.
- All equipment, fittings, etc. to be used shall be SABS approved.

No claims for extras in respect of failure by the Electrical Contractor to comply with any of the above regulations will be considered.

Where conflict exists between any of the above regulations and the specifications, the said conflict must be referred to the Engineer in writing for his ruling.

#### **2. NOTICES**

##### **2.1 General**

The successful Tenderer for this Contract shall, immediately after he has been officially notified that his tender has been accepted, and at any time thereafter as may be necessary, notify all the relevant authorities, pay fees and take any other steps which may be required or prescribed to execute the installation as specified.

##### **2.2 Compliance with Green Buildings Council of South Africa**

###### **Commissioning:**

Comprehensive pre-commissioning, commissioning, and quality monitoring are contractually

Contractor to provide the following:

- Detailed as-built drawings
- Commissioning reports
- Operations and Maintenance Manuals etc.
- Training of building management staff
- Contractor to provide short report on alternative materials (special consideration to PVC materials)
- Project timeline/program,
- Monthly monitoring-reporting; Corrective Actions; Tuning/Re-commissioning
- Contractor to provide EMP to professional team
- Contractor to implement waste management plan, retain waste records and issue quarterly reports to building owner. Reuse or recycling of 50% of waste

### **3. ELECTRICAL EQUIPMENT AND MATERIALS**

- 3.1 All equipment and fittings supplied must be in accordance with the attached General Electrical Specification, suitable for the relevant supply voltage and frequency and must be approved by the Department's representative.
- 3.2 Materials and equipment used in this Contract must, where possible, be of South African manufacture and shall comply with this specification and SANS 10142-1. Proof of compliance must be submitted prior to installation of any materials or equipment.
- 3.3 The Electrical Contractor shall submit samples of all materials or equipment for approval by the Engineer before installation, unless prior approval to the contrary has been obtained in writing from the Engineer. Such samples will be held for purposes of comparison with equipment and materials installed and will be released on satisfactory completion of the Contract.
- 3.4 All apparatus, components, fittings and materials supplied and/or installed, whether expressly specified herein or not, shall conform in respect of quality, manufacture, tests and performance, with the requirements of the South African Bureau of Standards and/or the appropriate current British Standard Specifications and Addenda thereto.
- 3.5 Where a certain manufacturer's material or apparatus is mentioned in the drawings or specifications, such materials or apparatus shall be provided as specified, excepting where an alternative to this condition is allowed in the specifications. Where a detailed specification for material or apparatus is not provided, it shall be understood that all normal requirements for the use of such materials or equipment shall apply.
- 3.6 Where certain products of a specified manufacturer are unobtainable, substitutes may be offered, but shall only be supplied after written consent by the Engineer.

### **4. DRAWINGS**

- 4.1 The Engineer's drawings covering the various sections of the installation are as stipulated in the schedule of drawings herein. The working drawings of the Contract shall, however, consist of:
  - The Engineer's drawings.
  - The Architect's drawings.
  - The Reinforced Concrete drawings.
  - The Civil Engineering drawings.
  - The Plumbing, Sprinklers and other Services drawings.
- 4.2 Unless otherwise specified, three sets of the Engineer's drawings will be issued to the Electrical Contractor for installation purposes. Any further copies shall be purchased from the Engineer.
- 4.3 Two copies of shop drawings shall be submitted to the Engineer for approval and to demonstrate compliance with Contract Documents. Shop drawings are drawings, diagrams, illustration, schedules, performance charts, brochures and other data which are prepared by the electrical contractor, manufacturer, supplier or distributor and which illustrate some portion of the work.
- 4.4 The Engineer's approval of shop drawings or samples shall not relieve the Electrical Contractor of responsibility for any deviation from the requirements of this Contract unless the Electrical Contractor has informed the Engineer in writing of such deviation at the time of submission of shop drawings or samples and the Engineer has given written approval for the specific deviation, nor shall the Engineer's approval relieve the Electrical Contractor of responsibility for errors or omissions in the shop drawings or samples.
- 4.5 A complete set of the Engineer's drawings shall be issued to the Electrical Contractor after installation to be marked up by the Electrical Contractor to indicate the "As-Built" installation as a prerequisite to completion.

- 4.6 The position of power points, switches and light points that may be influenced by built-in furniture must be established on site, prior to these items being built in.

5. **BALANCING OF LOAD**

The Contractor is required to balance the load as equally as possible over the multiphase supply.

6. **SERVICE CONDITIONS**

All plant shall be designed for the climatic conditions pertaining to the service.

7. **SUPPLY AND CONNECTION**

- 9.1 The Supply Authority is eThekweni Municipality

9.2 Details of Supply

Application will be made for a 100A three phase, 400V, and 50 Hz supply upgrade to the site.

9.3 Metering

The supply will be metered by eThekweni Municipality, within the meter Kiosk located within the premises.

9.4 Application

The electrical applications to eThekweni Municipality will be made by the electrical sub-contractor. Payment of connection fees will be made by the electrical sub-contractor, and a provisional sum has been allowed for in the bill of quantities to cover this item.

9.5 Existing Services crossing the Site

There are no known electrical services crossing the site.

9.6 Liaison

The electrical contractor will be required to liaise with eThekweni Municipality with regard to the timeous supply of power to the site.

8. **CABLES**

The Contractor shall supply and completely install all distribution cables as indicated on the drawings, and listed in the Schedule of Cables.

The storage, transportation, handling and laying of the cables shall be according to first class practice, and the contractor shall have adequate and suitable equipment and labour to ensure that no damage is done to cables during such operations.

The cable-trenches shall be excavated to a depth of 0,6m deep below ground level and shall be 450mm 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 two cable diameters apart throughout the run. The bottom of the trench shall be level and clean and the bottom and sides free from rocks or stones liable to cause damage to the cable.

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

In the trenches the cables shall be laid on a 75mm thick bed of earth and be covered with a 150-mm layer of earth before the trench is filled in.

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 jointers using first class materials or by means of approved epoxy-resin pressure type jointing kits such as "Scotchcast".

Epoxy-resin joints must be made entirely in accordance with the manufacturer's instructions and with materials stipulated in such instructions. Low tension PVCA cables are to be made off with sealing glands and materials designed for this purpose which must be of an approved make. Where cables are cut and not immediately made off, the ends are to be sealed without delay.

The laying of cables shall not be commenced until the trenches have been inspected and approved. The cable shall be removed from the drum in such a way that no twisting, tension or mechanical damage is caused and 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.

Backfilling (after bedding) of the trenches is to be carried out with 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.

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

Earth continuity conductors are to be run with all underground cables constituting part of a low tension distribution system. Such continuity conductors are to be stranded bare copper of a cross-sectional area equal to at least half that of one live conductors of the cable, but shall not be less than 4mm<sup>2</sup> or more than 70mm<sup>2</sup>. A single earth wire may be used as earth continuity conductor for two or more cables run together, branch earth wires being brazed on where required.

## **9. DISTRIBUTION BOARDS**

### **9.1 General**

In all instances where provision is to be made on boards for the supply authority's main switch and/or metering equipment the contractor must ensure that all requirements of the authorities concerned in this respect are met.

All busbars, wiring, terminals, etc., are to be adequately insulated and all wiring is to enter the switchgear from the back of the board. The switchgear shall be mounted within the boards to give a flush front panel. Cable and boxes and other ancillary equipment must be provided where required.

The Contractor shall supply and install the distribution boards as indicated on the drawings and listed in the drawings schedule. All distribution boards shall be equipped in accordance with the Single Line Diagrams and must be approved by the engineer and department before installation. The doors and architrave of the Distribution Boards shall be painted White. The front inside panels shall be Light Orange, colour B26 of SANS 1091.

All distribution boards shall have a minimum of 25% spare space. Where circuit breaker sizes are shown for spare ways on the single line diagrams, these circuit breakers shall be fitted at time of manufacture.

### **9.2 Internal wiring**

Standard 600/1 000 V grade PVC-insulated stranded annealed copper conductors to SANS 1507 shall be employed for the internal power wiring of switchboards. The smallest conductor size to be used for power wiring in switchboards shall be 2.5mm<sup>2</sup>. Flexible cord of minimum size 1,0mm<sup>2</sup> may be used for control wiring.

Where heat generating equipment is present and the internal temperature of the board is likely to exceed 50°C, silicon-rubber insulated stranded conductors shall be used.

Wiring shall be arranged in horizontal and vertical rows and shall be bound with suitable plastic straps or installed in PVC wiring channels. Under no circumstances may PVC adhesive tape be used for the bunching of conductors or for the colour identification of conductors.

Bunched conductors shall be neatly formed to present a uniform appearance without twisting or crossing the conductors. Conductors leaving the harnesses shall be so arranged that they are

adjacent to the chassis.

All wiring between different Panels within the same switchboard shall be installed in wiring channels.

Grommets shall be installed in each hole in the metal work through which conductors pass.

All wiring shall be installed away from terminals, clamps or other current carrying parts. Wiring shall also be kept away from exposed metal edges or shall be protected where they cross metal edges protected where they cross metal edges.

Where conductors change direction, smooth bends shall be formed with a radius of at least 5 times the outside diameter of the conductor or harness.

Where neutral connections are looped between the terminals of instruments, it is essential that the two conductor ends be inserted into a common lug or ferrule and are crimped or soldered together in order that the neutral connection is not broken when the conductors are removed from one of the instruments.

Wiring should as far as possible be confined to the front portions of switchboards for ease of access.

This requirement is important for wiring between smaller circuit-breakers and the associated main circuit-breaker as well as the wiring from circuit-breakers to lighting and socket-outlet circuits.

A maximum of two conductors will be allowed per equipment terminal. In the event of more conductors being connected to the same equipment terminal (e.g. a main circuit-breaker feeding other circuit-breakers), stub bus-bars shall be provided for the various conductors.

### **Load End Connections**

The supply end connections to all equipment shall under all circumstances be at the top and the load end connections at the bottom.

### **Wiring to Circuit-breakers**

Equipment with a rating exceeding the current rating of 70mm<sup>2</sup> conductors shall be connected by means of bus-bars to the main bus-bars. Looped connections may only be installed for a maximum of two outgoing circuits. Where there are more than two outgoing circuits, bus-bars shall be used and equipment connected individually to the bus-bars. Where miniature circuit-breakers are mounted in continuous rows and supplied by bus-bars connected to each MCB, each bus-bar shall be supplied by a separate conductor. This conductor shall be connected to the bus-bar by means of a separate lug and not via an MCB terminal.

### **Identification**

The colour of the conductors for all 220/250 V circuits shall correspond to the colour of the supply phase for that circuit. Neutral conductors shall be black.

All other conductors in the board, supplying control circuits, etc. shall be coded in colours other than those specified above. A colour code shall be devised for each board and the colour code shall be shown on the wiring diagrams.

All conductors that terminate at wiring terminals and all conductors used for the internal wiring of the switchboard shall further be identified at both ends by means of durable cable marking ferrules. PVC or other tape is not acceptable.

The numbers on the markers shall be shown on the wiring diagrams.

## **9.3 Labelling**

All distribution boards shall be provided with a legend card and holder. The legend card shall be typed, and shall indicate as a minimum the Circuit breaker number, the circuit type (e.g. Lighting, Power, Air Conditioning, etc), the Circuit Number as shown on the drawings, and a brief description of the circuit. For example, a lighting circuit shown as L1 on the drawings and fed by circuit breaker number 4 shall be labeled as follows:



<b>4</b>	<b>Lighting – L1 Reception, Offices 2, 3 and 4</b>
----------	--

All distribution boards shall be labeled with an engraved label, detailing the distribution board name, where the distribution board is fed from, the cable size, the Fault Level and the phase rotation, e.g.

<b><i>DB Name: DB 4</i></b>
<b><i>Fed from: DB 2</i></b>
<b><i>Size of cable: 16mm x 4C</i></b>
<b><i>Fault Level: 5kA</i></b>
<b><i>Phase Rotation: Clockwise</i></b>

Cascading labels shall be used for all sub-distribution boards with a nominal fault level of over 5kA, as well as on the Main LV Board.

The doors and architrave of the Distribution Boards shall be painted White.

The front inside panels shall be Light Orange, colour B26 of SANS 1091.

All distribution boards shall have a minimum of 25% spare space. Where circuit breaker sizes are shown for spare ways on the single line diagrams, these circuit breakers shall be fitted at time of manufacture.

#### 9.4 Circuit Breakers

All circuit breakers shall be of the same manufacture throughout.

All circuit breakers installed in the Meter Kiosk and Distribution Boards shall have an ultimate breaking capacity suitable for the installation, and shall not rely on cascading. All circuit breakers shall have standard breaking capacity trip curves. Circuit breakers with a nominal current rating of 100 to 250 Amps shall be equipped with an integral thermal magnetic trip unit, with adjustable long time and short time protection

#### 9.5 Schedule of Distribution Boards

Indicated is the minimum fault level rating (kA) of the busbars and all switchgear and the distribution board type.

BOARD	TYPE	COLOUR (BODY & DOORS)	MIN. FAULT LEVEL
Switchboard	Floor Standing	TBC	6kA
DB 1	Recessed	TBC	6kA
DB 1A	Recessed	TBC	6kA
DB 2	Recessed	TBC	6kA
DB2A	Recessed	TBC	6kA
DB3	Recessed	TBC	6kA
DB4	Recessed	TBC	6kA
DB5	Recessed	TBC	6kA
DB6	Recessed	TBC	6kA
DB7	Recessed	TBC	6kA

## 10. CABLE LADDER AND TRAY

Cable ladder shall be supplied and installed in all areas where cables run in ceiling voids or down walls.

The Cable ladder shall be galvanized steel. All cable ladders shall come complete with purpose made accessories. The cable ladder shall be suspended from roof trusses at centers not exceeding those specified by the manufacturer, and before and after each bend. Alternatively, cable ladders shall be supported by brackets fixed to the wall, spaced at intervals recommended by the manufacturer.

Cables on the cable ladder shall be spaced such that the separation between the cables is a minimum of twice the cable diameter. The cables shall be properly secured to the cable ladders

## 11. CONDUIT AND WIRING

### 11.1 Conduit

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, parts 1 and 2.
- b) Plain-end metallic conduit and accessories: SANS 1065, parts 1 and 2.
- c) Non-metallic conduit and accessories: SANS 950

All conduit fittings except couplings shall be of the inspection type. Where cast metal conduit accessories are used, these shall be of malleable iron. Zinc base fittings will not be allowed.

Bushes used for metallic conduit shall be brass and shall be provided in addition to locknuts at all points where the conduit terminates at switchboards, switch-boxes, draw-boxes, etc.

Draw-boxes are to be provided in accordance with the "Wiring Code" and wherever necessary to facilitate easy wiring.

For light and socket outlet circuits, the conduit used shall have an external diameter of 20mm. In all other instances the sizes of conduit shall be in accordance with the "Wiring Code" for the specified number and size of conductors.

Only one manufactured type of conduit and conduit accessories will be permitted throughout the installation.

Running joints in screwed conduit are to be avoided as far as possible and all conduit systems shall be set or bent to the required angles. The use of normal bends must be kept to a minimum with exception of larger diameter conduits where the use of such bends is essential.

All metallic conduit shall be manufactured of mild steel with a minimum thickness of 1,2mm for plain-end conduit and 1,6mm in respect of screwed conduit.

Under no circumstances will conduit having a wall thickness of less than 1,6mm be allowed in screeding laid on top of concrete slabs.

Bending and setting of conduit must be done with special bending apparatus manufactured for the purpose and which are obtainable from the manufacturers of the conduit systems. Damage to conduit resulting from the use of incorrect bending apparatus or methods applied must on indication by the Department's inspectorate staff, be completely removed and rectified and any wiring already drawn into such damaged conduits must be completely renewed at the Contractor's expense.

Conduit and conduit accessories used for flame-proof or explosion proof installations and for the suspension of luminaires as well as all load bearing conduit shall in all instances be of the metallic screwed type.

Tenderers must ensure that general approval of the proposed conduit system to be used is obtained from the local electricity supply authority prior to the submission of their tender. Under no circumstances will consideration be given by the Department to any claim submitted by the Contractor, which may result from a lack of knowledge in regard to the supply authority's requirements.

### **Conduit in Roof Spaces**

Conduit in roof spaces shall be installed parallel or at right angles to the roof members and shall be secured at intervals not exceeding 1,5m by means of saddles screwed to the roof timbers.

Nail or crampets will not be allowed.

Where non-metallic conduit has been specified for a particular service, the conduit shall be supported and fixed with saddles with a maximum spacing of 450 mm. The Contractor shall supply and install all additional supporting timbers in the roof space as required.

Under flat roofs, in false ceilings or where there is less than 0,9m of clearance, or should the ceilings be insulated with glass wool or other insulating material, the conduit shall be installed in such a manner as to allow for all wiring to be executed from below the ceilings.

Conduit runs from distribution boards shall, where possible terminate in fabricated sheet steel draw-boxes installed directly above or in close proximity to the boards.

### **Chases and Builders Work**

Except where otherwise specified the Builder or Main Contractor shall be responsible for the builder's work related to the installation of conduits, outlet boxes, switchboard trays, bonding trays and other wall outlet boxes and will undertake the necessary chasing and cutting of walls and the provision of openings in ceilings and floors for luminaries and other electrical outlets. The Contractor shall notify the Builder or Main Contractor of his requirements and the responsibility lies with the Contractor to ensure that all builder's work is clearly indicated or marked in accordance with his requirements.

Electrical materials to be built in must be supplied, placed and fixed in position by the Contractor when required to do so by the Builder or Main Contractor. The Contractor shall also ensure that these materials are installed in the correct positions.

Where no Builder or Main Contractor is available, the Contractor must provide all chases and is required to cover conduits installed in chases by a layer of 4:1 mixture of coarse sand and cement, finished 6 mm below the face of the plaster and roughened. Chases shall be deep enough to ensure that the top of conduits are at least 12 mm below the finished surface of the plaster.

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

This ruling is particularly applicable but not exclusively to the rewiring and renewal of existing installations. Chases shall be made by means of a cutting machine.

Under no circumstances shall face brick walls or finished surfaces be chased or cut without the written permission of the Department. Where it is necessary to cut or drill holes in the concrete structure, the prior permission of the Department shall be obtained.

## **Surface Mounted Conduit**

Wherever possible, the conduit installation is to be concealed in the building work; however, where unavoidable, conduit installed on the surface must be plumbed or levelled and only straight lengths shall be used.

The use of inspection bends is to be avoided and instead the conduit shall be set uniformly and inspection coupling used where necessary.

No threads will be permitted to show when the conduit installation is complete, except where running couplings have been employed.

Running couplings are only to be used where unavoidable, and shall be fitted with sliced couplings as a lock nut.

Conduit is to be run on approved spaced saddles rigidly secured to the walls.

Alternatively, fittings, tees, boxes, couplings etc., are to be cut into the surface to allow the conduit to fit flush against the surface. Conduit is to be bedded into any wall irregularities to avoid gaps between the surface and the conduit.

Crossing of conduits is to be avoided; however, should it be necessary purpose-made metal boxes are to be provided at the junction. The finish of the boxes and positioning shall be in keeping with the general layout.

Where several conduits are installed side by side, they shall be evenly spaced and grouped under one purpose-made saddle.

Distribution boards, draw-boxes, industrial switches and socket outlets etc., shall be neatly recessed into the surface to avoid double sets.

In situations where there are no ceilings the conduits are to be run along the wall plates and the beams.

Painting of surface conduit shall match the colour of the adjacent wall finishes.

Only approved plugging materials such as aluminium inserts, fibre plugs, plastic plugs, etc., and round-head screws shall be used for fixing saddles, switches, socket outlets, etc., to walls, wood plugs and the plugging in joints in brick walls are not acceptable.

## **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. Sharp bends of any nature will not be allowed in concrete slabs.

Draw and/or inspection boxes shall be grouped under one common cover plate and must preferably be installed in passages or male toilets.

All boxes, etc., are to be securely fixed to the shuttering to prevent displacement when concrete is cast.

The conduit shall be supported and secured at regular intervals and installed as close as possible to the neutral axis of concrete slabs and/or beams.

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

### **Flexible connections for connecting up of stoves, machines, etc.**

Flexible tubing connections shall be of galvanised steel construction, and in damp situations of the plastic sheathed galvanised steel type. Other types may only be used subject to the prior approval of the Department's site electrical representative.

Connectors for coupling onto the flexible tubing shall be of the gland or screw-in types, manufactured of either brass or cadmium or zinc plated mild steel, and the connectors after having been fixed onto the tubing, shall be durable and mechanically sound.

Aluminium and zinc alloy connectors will not be acceptable.

## **11.2 Wiring**

Except where otherwise specified, 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 and all conduit ends provided with bushes. All conduits to be clear of moisture and debris before wiring commenced.

Unless otherwise specified on the service drawings, the wiring of the installation shall be carried out in accordance with the "Wiring Code". Further to the requirements concerning the installation of earth conductors to certain light points as set out in the "Wiring Code", it is a specific requirement of this document that where plain-end metallic conduit or non-metallic conduit has been used, earth conductors must be provided and drawn into the conduit with the main conductors to all points, including all luminaires and switches throughout the installation.

Wiring for lighting circuits is to be carried out with 1,5mm<sup>2</sup> conductors and a 1,5mm<sup>2</sup>-earth conductor. For socket outlet circuits the wiring shall comprise 4mm<sup>2</sup> conductors and a 2,5mm<sup>2</sup>-earth conductor. In certain instances the sizes of the aforementioned conductors may be increased for specified circuits. Sizes of conductors to be drawn into conduit in all other instances, such as feeders to distribution boards, power points etc., shall be as specified elsewhere in this specification or indicated on the drawings. Sizes of conductors not specified must be determined in accordance with the "Wiring Code".

The loop-in system shall be followed throughout, and no joints of any description will be permitted.

The wiring shall be done in PVC insulated 600/1000 V grade cable to SABS 150.

Where cable ends connect onto switches, luminaires 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.

## **12. COMMUNICATION SYSTEMS**

### **12.1 Telephone Installation**

The size of all telephone conduits shall be 25mm diameter, and must be installed in the power skirting.

End boxes must consist of a 100mm x 50 mm x 50mm outlet box, flush mounted for access into power skirting or fitted with suitable RJ11 outlets and cover plates at a height above floor level as indicated on the drawings. Telephone outlets on power skirting shall consist of a RJ11 outlet mounted on a suitable cover plate.

## **12.2 Data Installation**

The Contractor shall allow for the complete supply and installation of all conduits, outlet boxes and distribution boards required for the data installation as shown on the drawings.

The size of all data conduits shall be 25mm where one data outlet is supplied, and 32mm diameter for two or three data outlets near each other, and must be installed in the floor slab. Galvanized steel draw-wires shall be installed in all conduits. A maximum of three outlets are allowed per conduit run. Data outlets shall consist of a RJ45 outlet, mounted in a suitable cover plate.

The DATA-DB shall consist of a flush mounted steel distribution board, with a removable door / cover. The size of the distribution board shall be 600 x 600mm.

End boxes must consist of a 100mm x 100 mm x 50mm outlet box, flush mounted for access into power skirting.

## **13. WIRING CHANNELS AND POWER SKIRTING**

### **13.1 Wiring Channels**

Wiring channels shall be used where indicated on the drawings.

Channels shall be manufactured of rolled sheet steel. The covers shall be snap-in PVC covers.

Wiring supports shall be provided in order to prevent the wires falling out when the covers are removed.

Channel sizes are generally as follows, unless indicated otherwise on the drawings:

Suspended Lighting Installations	P 4000
Telephone Reticulation	P 2000
Data Reticulation	P 9000
Security Reticulation	P 9000

### **13.2 Power Skirting**

The Contractor shall be responsible for the supply and installation of all power skirting complete with custom made corner pieces, end pieces, junction pieces, supply conduits, cover plates and power outlets as specified and indicated on the drawings.

The power skirting must comply with SANS 1197. The Contractor must ensure that the power skirting is installed to satisfaction of the clients representative before commencing with the wiring of the power trunking.

The power skirting shall be two compartment, 2 cover, metal power skirting, of a modular type. Powerskirting shall measure 55mm x 165mm x 3000mm, and shall be supplied complete with its own cover plate. The colour of the power skirting shall be grey. Corporate connections or similar power management to be used. The compartments shall be dedicated to power, telephone services and data services respectively. All panels to be riveted, not spot welded.

In general office space the power skirting shall be installed 20mm above the finished floor level. The power skirting shall be aligned using a chalk line, and not follow the line of the floor. Where power skirting is shown at built in counters or desks, the power skirting shall be installed on the wall, 100mm above the desk or counter, where against a wall, or directly below the counter top, where no wall is present.

## **14. SWITCHES AND SOCKET OUTLETS**

The installation of switches and socket outlets must conform to SANS 10142.

### **14.1 Switched Socket Outlets and Isolators**

All Switched socket outlets shall be flush mounted in 100 x 100mm conduit boxes, or shall be mounted on power skirting, as shown on the drawings. Generally wall mounted switched socket outlets shall be mounted at +300mm above finished floor level in offices and general admin areas, and at +1200mm above finished floor level in kitchens, staff rooms and stores. Final positing must take into account the furniture layout and drawings of other disciplines as refereed to in item 4.1.

Dedicated Switched socket outlets for computer outlets shall have a red trim and red covers where flush mounted, or cover to suit the power skirting. These outlets shall have shaved earth pins.

Switched Socket Outlets and Flush mounted Isolators shall be Type Clipsal Range or other approved.

### **14.2 Light Switches**

All light switches shall have white levers / toggles, and a white cover plate.

All light switches shall be Type Clipsal Range or other approved.

All switches shall be suitable for mounting in 100 x 50 x 50mm boxes shall comply with SANS 1663 and shall bear the SANS mark.

Switches shall have protected terminals for safe wiring. Contacts shall be of silver material.

On multi-lever switches, it shall be possible to individually change any of its switches. The yoke strap shall be slotted to allow for easy alignment.

The covers of surface mounted switches shall have toggle protectors.

### **14.3 Occupancy Sensors**

All occupancy sensors are to be ceiling flush mounted and have a dual movement function (Infrared and Ultrasound movement)

The occupancy sensors shall have a range of 38m<sup>2</sup> @ 2.5m fitting height and a 360° detection range as well as a 15min delay (variable).

## **15. LIGHT FITTINGS AND LAMPS**

The installation and mounting of luminaires must conform to SANS 10114.

### **15.1 General**

All fittings to be supplied by the Contractor shall have the approval of the Engineer and Client. No Incandescent lamps will be allowed for the entire contract. All luminaires supplied must have the SANS-1464 mark.

All linear fluorescent lamps shall be TL5 cool white or equivalent and approved. The lamps shall be recyclable.

All luminaires shall be submitted for approval, prior to orders being placed. Photometric data shall accompany each fitting.

All luminaires shall be power factor corrected to a minimum of 0.85.

All fluorescent light fittings shall be supplied with electronic control gear.

## **15.2 Schedule of Light Fittings**

The light fittings must be of the type specified in the Schedule of Light Fittings as are generally utilized in a building environment as listed within the following table. All luminaires are to be approved and tested by the South African Bureau of National Standards – (SANS). Luminaire testing certificates are to accompany each proposal by contractor.

Lighting types within the Bill Of Quantities under item 3.1.

## **16. POWER POINTS**

Allow for the installation of power points and equipment as listed in BOQ under item 3.3.

### **16.1 Water Heaters**

The contractor shall electrically connect all water heaters by means of flexible conduit connection from the isolator to the geyser.

Details with regard to the exact positions of the isolator for the water heaters must be coordinated with the plumber on site.

All water heaters shall be supplied from a 20 Amp Double pole isolator adjacent to it.

### **16.2 Air Conditioning Units and Fans**

The supply and installation of air conditioning units and fans shall be done by others. The electrical sub-contractor shall allow for the supply and installation of isolators for all units and fans, in accordance with the specification and the drawings. Final connections between the isolators and the equipment shall be done by the air conditioning and ventilation sub-contractor

### **16.3 Stoves**

The supply and installation of stove unit shall be done by others. The electrical sub-contractor shall allow for the supply and installation of isolators for all units, in accordance with the specification and the drawings.

## **LIGHTNING PROTECTION SYSTEM**

## **17. LIGHTNING PROTECTION**

### **17.1 Lightning Protection System**

The provision of a lightning protection system is mandatory for this installation. Prior to carrying out the installation, the specialist sub-contractor shall test the soil resistivity of the area and report to the Engineer on the sufficiency of the design for the site conditions.

The earth termination system shall consist of an earthing arrangement with vertical earth electrodes.

Neither the roof structure nor the gutters are acceptable for use as part of the system, and roof conductors and down conductor will have to be installed.

At least one equipotential bonding bar shall be provided in each building, for the bonding of the lightning protection systems, electrical and telecommunications installations and building



steelwork. All buildings shall be bonded together to form an equipotential system.

Test joint boxes are to be supplied above every earth electrode.

## **17.2 Earth Electrodes**

Earth electrodes shall be solid copper rod earth electrodes.

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

The length of the earth electrodes shall suit the soil resistivity of the area.

The installation of the earth electrodes shall include the drilling, excavation and backfilling of holes.

## **17.3 Couplings and Conductor Clamps**

Earthing electrodes shall be supplied with an adequate number of couplings.

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 thin walled tubes and hydrocarbon or silicon grease to seal the joint.

Conductor clamps shall be provided to suit the type and size of rods provided and the size and type of conductor.

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

An adequate number of driving caps or bolts shall be supplied with the rods to protect the ends of the earthing rods whilst being driven into hard soil.

## **17.4 Testing and Commissioning**

The sub-contractor shall be responsible for the testing and commissioning of the system, and the provision of a Certificate of Compliance in accordance with SANS 0313:1999.

The sub-contractor shall provide full test results PRIOR to the installation and AFTER the installation has been completed of the installation, and "as-built" drawings, showing the reading positions, earth electrode length, test readings and conductor sizes.

## **18. BILL OF QUANTITIES**

- (a) All prices shall be quoted in the currency of the Republic of South Africa and shall not be subject to adjustment except in terms of the conditions stated by the Tenderer. In the event of the Tenderer not stating his conditions for price adjustment his prices will be held to be firm and holding throughout the duration of the Contract.
- (b) The work scheduled hereunder is generally more fully described in the Specification or shown on the Drawings, and in pricing his tender the Tenderer is referred to the whole of the Conditions of Contract, Specification, Drawings and Schedule of Quantities, in order to fully comprehend the scope, extent and meaning of each Item scheduled.
- (c) Any costs involved in meeting the obligations and liabilities imposed by the Conditions of Contract and in complying generally with the requirements of the Contract shall be deemed to be apportioned to and included under the various items, and the prices quoted against each

item must cover the full inclusive cost of all work to be completed under the item plus such apportionment of the general costs.

- (d) Where there is any discrepancy in the tender between quoted rates, scheduled quantities and totals, the quoted rates shall in all cases be taken as the correct figures and the Tender shall be adjusted accordingly.
- (e) The prices quoted in this Schedule are to be those applicable if the Tenderer is awarded the contract as a whole.
- (f) Value Added Tax is to be included in the appropriate item of the Schedule of Quantities.

# GENERAL ELECTRICAL SPECIFICATION

## GENERAL SPECIFICATION

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## **GENERAL SPECIFICATION**

### **1.1 GENERAL**

#### **1.1.1 General Aspects**

In this document the term "Contractor" shall mean the Contractor appointed in terms of this document, irrespective of whether the contract is a direct contract with the client or a sub-contract with a Principal Contractor.

Prices tendered for equipment specified by trade names or catalogue references must be for the type and manufacture specified. If it is desired to use substitutes, the onus will be on the Contractor to prove that such substitutes are similar and equivalent to the article specified and meet with the approval of the Engineer in writing. The decision whether the tendered articles are acceptable shall rest solely with the Engineer. The cost implications of such substitutes shall be allowed for in the tendered amount.

Tenderers are required to enter at the time of tendering in the Schedules of Equipment and Materials Offered, the manufacturers of the materials, on which their tender is based, and the catalogue numbers and other information by which the materials may be identified. Technical brochures of the equipment offered shall be submitted with the tender to enable the unit concerned to be identified without ambiguity.

Tenderers shall only offer equipment for which proven backup is available in South Africa.

The Project Specification shall take preference over this General specification where any conflict exists.

Should the Tenderer become aware of any discrepancies or apparent discrepancies in these documents, he shall notify the Engineer thereof.

All materials and equipment used shall be of new and represent the manufactures latest product range.

If requested by the Engineer, the Contractor shall submit samples of cables, terminals, labels, trunks and other construction materials which he proposes to use on the installation for the Engineer's approval.

All materials and equipment used shall be suitable for the environment and service for which it is to be used. This pertains; inter alias, to corrosion protection, UV stability etc.

Equipment offered shall be small enough to be moved through the available doorways, passages, etc, to their final locations.

Dimensions scaled from drawings shall not be used to obtain lengths of trays, trunks, cables etc. The runs shall be measured on site.

The Contractor shall make due allowance for other Contractors' operations in progress concurrent with his own activities.

### 1.1.2 General Installation Requirements

NO DEVIATION FROM THE SPECIFICATION will be tolerated or paid for without the written approval of the Engineer.

The installation shall comply in each instance with the requirements as set by the CLIENT and Engineer, in particular to the general specifications for the various electronic subsystems, as well as all relevant SANS codes of practice and standards.

Where no SANS guideline exist, the IEC, EN and ANSI standards will be applicable.

The installation shall be done in accordance with the drawings issued by the Engineer as approved by the Client and no installation work shall be carried out without issued for construction drawings.

All routing requirements and conduit installation work shall be done by as part of this contract and all additional reticulation routes required by the Tenderer shall be indicated and marked on his drawings and submitted to the Engineer for approval.

At the end of each day, the Contractor shall be responsible for the clean up, removal, and secure disposal of all debris.

Any damage to protective coatings, equipment, services or structures caused by the Contractor shall be made good.

The Contractor shall prevent pollution caused by spillages of fuels and lubricants, etc.

Only technicians and artisans with adequate and applicable training and experience shall be used to carry out the work on this contract.

If installation commences with any type of material or equipment, then the same type shall be used throughout the contract.

## 1.2 STANDARDS AND REGULATIONS

### 1.2.1 National Standards and Regulations

The following regulations, standards, codes of practice and guidelines are referenced in this document. They are all subject to revision and users of this specification must use the most recent editions of those listed below.

In particular the Works shall comply with the following regulations:

- Electricity Act (Act No. 41 of 1987) as amended
- Occupational Health and Safety Act (Act No 85 of 1993) as amended
- The Environmental Conservation Act (Act No 73 of 1989) as amended
- Provincial Road Traffic Ordinance and regulations
- SANS 10139, 2012: Edition 3.2 Fire detection and alarm systems for buildings – system design, installation, and servicing
- The wiring of premises (SANS 10142)
- National Building Regulations Act No 103 of 1977
- SANS 10400, 1990: The application of the national building regulations
- SANS 9000:2005/ISO 9000:2005: Quality management systems - Fundamentals and vocabulary
- The local Councils bye laws as well as the local Supply Authority Regulations.

1.2.2 In addition the Contractor shall issue all notices and pay all the required fees in respect of the Installation to the local authorities and shall exempt the Employer from all losses, costs or expenditures which may arise as a result of the Contractor's negligence to comply with the requirements of the regulations enumerated in this specification.

1.2.3 It shall be assumed that the Contractor is conversant with the abovementioned requirements. Should any requirement, bye-law or regulation which contradicts the requirements of this specification, apply or become applicable during erection of the Installation, such requirement, bye-law or regulation shall overrule this specification and the Contractor shall immediately inform the Engineer of such a contradiction. Under no circumstances shall the Contractor carry out any variations to the Installation in terms of such contradictions without obtaining the written permission to do so from the Engineer.

#### 1.2.4 Standing Instruction

In addition to complying with the OHS Act the Contractor shall also adhere to the standing instructions applicable to the site as issued from time to time by the Engineer and/or Employer.

#### 1.2.5 Safety

Noise control, environmental aspects, aesthetics and staff comfort all to adhere to the OHS Act.

### 1.3 COMPLIANCE TO THE SPECIFICATION

1.3.1 The Contractor shall comply with all the requirements as per this specification. Proposed deviations shall only be considered after the award of the contract.

1.3.2 Proposed deviations shall only be accepted if it meets with all of the following criteria:

The proposed deviation offers a substantial improvement to the final product offered.

The proposed deviation has been proven in other applications.

1.3.3 Any deviations from the specifications can only be implemented with prior approval from the various representatives from both the Client and the Engineer.

### 1.4 PROVEN PRODUCT

1.4.1 Due to the security nature of these requirements and the criticality of this application only proven products shall be considered.

1.4.2 Products could be approved only after investigation by all applicable parties.

1.4.3 The guidelines for similar applications demands that five installations have to be operational in accordance with the above requirements for a minimum period of no less than one year before a product will be considered to be a proven product.

### 1.5 CABLING

#### 1.5.1 General

Supply, install, connect, and terminate all cabling necessary to complete the installation of audio, data, control, communications and device cabling.

All cabling shall be supplied and installed as a part of this contract.

All terminated cabling shall be neatly tied/loomed to prevent damage to terminations and interference or obstruction of other services.

Strain relief shall be provided for cables connected to rack mounted equipment.

All cables shall have stranded copper conductors and shall be PVC insulated with overall PVC sheath, unless otherwise specified.

All cabling shall be concealed and installed on metal cable tray, cable duct and conduits.

Cabling shall be installed with due regard to future removal and replacement of cables.

All cables shall be new and delivered on site in unbroken reels, and with the "manufacturer's" label attached.

Due consideration shall be given to voltage drop when calculating cable sizes.

Installation and cable route shall be to the satisfaction of the Engineer.

Cables shall be installed in a manner eliminating any possibility of strain on the cable itself or on cable terminations.

No joints or connections will be permitted. Adequate loose cable shall be left behind all equipment to facilitate removal for inspection, adjustment or replacement.

Any bending, jagged edges or any other forms of damage or deformation of cable trays or wire ways shall be made good, before cables are installed.

Conduit shall be thoroughly cleaned and have all burrs removed before the drawing in of any cable.

The tray shall be supported at every change in direction of the cable tray route. The minimum radius of any bend of the tray is to suit the minimum bending radius of the largest cable on the tray.

Cable trays shall be firmly secured in position in such a manner to cause as little obstruction to walkways etc., as possible.

Hangers, supports and anchors for wire ways and equipment, shall be designed and installed with regard to appearance and convenience as well as for adequate strength and rigidity. Only professional quality fixing material and methods shall be used. Nails and glue are not acceptable.

#### 1.5.2 Cable Damage

During the installation of cable should any kinks or abrasions to insulation, braiding, sheathing or armouring occur, the affected cable shall be withdrawn and replaced with new cable at no additional cost to the client.

#### 1.5.3 Cable Numbering

Generally all cables shall be allocated and identified with a unique cable number.

All cables including patch leads shall be clearly labelled. Labels shall be affixed within 250mm of each termination.

Cables shall be fitted with tags at the following points:

- On the cable sheath next to the gland at each end
- In cable pits/manholes
- In all vertical data risers
- At any additional point on the cable sheath (or around the core bunch) where the preceding requirements are not readily traceable from the core terminations
- Any inspection/junction box

Cable identification tags shall be orientated uniformly to read left to right from the logical viewing point horizontally; and from bottom to top viewed from the right where installed vertically.

Duplication of cabling and equipment identities shall not be allowed.

#### 1.5.4 Coordination and Separation of Services

Install services for each respective section and system and physically separate from other systems to a discipline and coordinated layout plan. Adjacent services shall run approximately parallel. Crossing services shall cross at approximate right angles.

Individual services between common points of the work shall follow similar parallel routes. Cables shall be parallel to the building major axes.

Separation distances shall not be less than the following:

- Power cables – 100mm.
- ELV and Communication cables to parallel power cables – 300mm
- ELV and Communication cables to power cables crossed at 90 – 100mm.
- Any trade to finish floor level – 80mm
- Any trade to structure – 20mm.

#### 1.5.5 Coordination and Feasibility

The drawings, schematics and specification indicate the main routes and positions for the various services installations and equipment in relation to the building and other services.

Check the details shown on the drawings and co-ordinate the details layout with the building structure and other services. Submit full details of proposed major cable routes for approval before proceeding.

The Contractor shall deliver to the Engineer in accordance with the scheduled works program:

- Details of all types of cabling to be installed as part of the contract works
- Block schematic cable diagrams indicating all system interconnecting cables including cable routes and cable types complete with core make up and numbers
- Detailed floor plans indicating cable routes and designated circuit identification
- Wiring diagram detailing system interconnections and cable/core identification

#### 1.5.6 Special Cabling

Where equipments to be supplied and installed under this specification requires special cabling (i.e. screened cables, unshielded twisted pair, coaxial, optical fibre or other special types of cable), these cables shall be provided as part of this contract.



It shall remain the responsibility of the Contractor to design the cabling system network and determine the type of cable required for interconnection of the various components, which make up the total system to be installed, to comply with the contract documents.

## **1.6 WIRE TERMINATING AND MOUNTING HARDWARE**

- 1.6.1 Every terminal strip shall be numbered or named.
- 1.6.2 Every terminal shall be numbered.
- 1.6.3 Cable glands shall be of the compression ferrule type with "O" ring seals.
- 1.6.4 Wherever possible, terminations of cable cores and wires shall be made using spade, pin or bootlace ferrule type crimp-on lugs.
- 1.6.5 Lugs may only be crimped with controlled pressure crimping tools of the correct size for the lug used.
- 1.6.6 Thin, collapsing pipe type ferrules shall not be used.
- 1.6.7 High quality wire strippers shall always be used and care taken not to nick or otherwise damage the strands.
- 1.6.8 Terminals shall be located so that all connections can be made easily.
- 1.6.9 When wiring of different potentials and types of supply use the same terminal rail, a clear space or barrier shall be provided between terminal blocks.

## **1.7 EARTHING SPECIFICATIONS**

- 1.7.1 The Earthing connection to the security equipment shall be no more than a 1 $\Omega$  connection. The Earthing shall be done from a single (SPUR Distribution Point) point to each part of the security installation e.g. Equipment/Wiring Closets, Service and Central Equipment Locations etc.
- 1.7.2 No daisy chaining of the Earthing connection shall be allowed, except as described in the section on high-rise buildings. The reticulation for the earth connection shall be done with no less than 70 mm<sup>2</sup> Green Isolated Copper Conductor (GICC). The same spur point shall be connected to the Electrical Earth. The connection to the Electrical Earth can be done with Bare Copper Conductor (BCC) with a cross sectional area of no less than 70 mm<sup>2</sup>.
- 1.7.3 The copper conductors shall be terminated in a lug which shall be bolted to the Earthing bar. The Earthing bar shall not be smaller than 6mm x 50mm x 300mm. No more than 1 conductor per lug and no more than 1 lug per terminal point on the earthing bar will be tolerated. The lugs shall be crimped or CAD welded to the conductor and shall be inspected by the Engineer prior to acceptance. The Security and Electrical Earths shall be run in separate conduits and be separated by no less than 1 m. The Earthing conductors may cross each other and any other electrical cable at a 90° angle.
- 1.7.4 All Earthing bars, screws, lugs & isolators shall comply with the SANS 0142 Wiring Code, SANS Earthing Specification & all relevant IEC standards.
- 1.7.5 Any conducting material that has been anodized, e.g. aluminium may not be used as an earth bus-bar unless special precautions have been taken to ensure that the anodizing material has been removed where the earthing connections are made.

- 1.7.6 All connections between racks or sub-racks used to transmit audio, video, radio frequency or digital data must be made using co-axial type wiring having the correct matching impedance and must be to the manufactures specification.

## **1.8 LIGHTNING AND SURGE PROTECTION SPECIFICATION**

- 1.8.1 The Contractor shall provide and install all the necessary surge protection devices, for the protection of the electrical/electronic control equipment, communication and data lines. Surge Protection devices shall protect all AC and DC circuits from the effect of lightning induced over voltages, internally generated transients and utility switching transients.
- 1.8.2 Surge protection will be required on the incoming power supply to the electronics equipment and shall be done at the single point where the supply enters the building. Lightning protection shall be installed from Live to Earth (L-E), Neutral to Earth (N-E) and from Live to Neutral (L-N) on a single phase supply. If a 3 phase supply is used lightning protection shall be required on each phase individually (L1-E, L2-E, L3-E & N-E). If the same supply is reticulated to another building additional lightning protection shall be required where it enters the next building. The protection shall be as described above.
- 1.8.3 The Tenderer has to allow for additional surge suppression and voltage stabilisation equipment if this is required to protect his equipment or to guarantee its correct operation.
- 1.8.4 The test pulses shall be applied at intervals of not less than one minute.
- 1.8.5 The surge protection equipment may be built into the equipment being protected. If the provided internal protection is inadequate to meet this specification, then additional external protection has to be provided.
- 1.8.6 There shall be an earth bar in the lower corner of each enclosure and shall be sized to accept a 16mm square BCW. The Bare Copper Wire shall be terminated at the nearest earth mat.
- 1.8.7 AC protection devices can be located in the equipment cabinet and must be installed prior to any distribution (i.e. multi-outlets).
- 1.8.8 Surge protection devices shall be chosen in such a way that the protected circuit shall still function to specification in spite of the introduction of series and/or shunt impedances by the protecting devices.

## **1.9 EQUIPMENT FIXING REQUIREMENTS**

- 1.9.1 Under no circumstances shall double sided tape be used any where on this installation for whatever purpose.

### **1.9.2 Specific Surface Requirements**

Drywall - Dry wall plugs, Toggle Bolt anchors (Butterfly nuts) or Superfast™ Toggle anchors may be used to fix equipment, conduit or trunking.

Brick Walls - HILTI, Fisher, UPAT or RAWL type plugs are acceptable for fixing equipment, conduit or trunking.

Concrete - HILTI gun, RAWL bolts or chemical bolts are an acceptable means of fixing equipment, conduit or trunking.

Ceilings - For suspended ceilings, Toggle Bolts anchors (Butterfly nuts) or Superfast™ Toggle anchors are an acceptable means of fixing equipment, conduit or trunking. Drywall screws will also be acceptable if they are screwed directly into the support struts. For normal ceilings Toggle Bolt anchors (Butterfly nuts) or Superfast™ Toggle anchors are an acceptable means of fixing equipment, conduit or trunking.

Steel - Up to 3mm: Self tapping screw with drill, a self tapping screw or aluminium pop rivets (except for door hinges) are an acceptable means of fixing equipment, conduit or trunking. Above 3mm: bolts and nuts are an acceptable means of fixing equipment, conduit or trunking.

Wood - Drywall screws are an acceptable means of fixing equipment, conduit or trunking.

Aluminium - A self tapping screw or aluminium pop rivets (except for door hinges) are an acceptable means of fixing equipment, conduit or trunking.

#### 1.9.3 Specific Equipment Instructions

Alarm Wire - A glue gun or contact adhesive shall be used.

Trunking - Shall be fixed at minimum intervals of 1m.

Conduits - Raised aluminium saddles shall be used if the conduit is installed surface mount.

### 1.10 SIGNS, MARKERS, NAMEPLATES AND TAGS

1.10.1 All cable cores and wires shall be numbered at all termination points with "slip-on" interlocking type cable markers. Split-ferrule types are unacceptable. In the case of multi-core cables each core shall be numbered.

1.10.2 Signs, Markers, Nameplates and Tags shall be totally:

UV-resistant;

Fade-resistant;

Corrosion resistant;

Shall have a minimum life expectancy of 10 years.

Shall not be damaged by any commercially available solvent

#### 1.10.3 Cable Tags

Labels shall be colour-coded and include alphanumeric text 8 to 10 characters long.

For the labelling of cables any one of the following methods is acceptable:

- Cable-Tie Markers
- Clip-On Labels
- Printable Slide-In Labels

#### 1.10.4 Nameplates

In order for a technician to easily identify equipment locations a 250mm x 200mm sign shall be installed on the door of the field cabinet.

The sign shall be precision engraved letters and numbers with uniform margins.

Character sizes shall be a minimum of 50mm high.

All nameplates shall be permanently attached.

### 1.11 EQUIPMENT RACK CABINETS AND JUNCTION BOXES

#### 1.11.1 General

To save space inside the equipment room, and to keep the installation neat, equipment shall be installed in the 19" racks and junction boxes.

All pure technical equipment like the storage servers, surge protectors etc., shall be fit into 19" rack enclosures accessible from two sides (front and rear). Those racks shall be protected against dust and freezing as against excessive heating.

All rack enclosures shall be black powdered coated. The cabinets shall also include all power and cable management articulation.

#### 1.11.2 Floor Standing Equipment Rack Cabinets

The cabinets shall be lockable and the key will be controlled by the Client.

The racks shall comply with the following specifications:

- Colour/Finish: Powder-coated, black;

- Fixed 19" installation front and rear, for components in accordance with IEC 297-3;
- Flexible mounting for components with T-slot mountings;
- Cable entry via the plinth and top cover;
- The rack enclosures shall have a complete ventilation system built-in to ensure adequate airflow. This shall be accomplished by installing a perforated front and back doors and extraction fans the top of the rack enclosure;
- Door open angel 180°.
- Cross connecting jumper space shall be at least 120mm to the front and rear;
- An IP40 protection rating;
- Load rating shall be 500kg, static;
- Height: 15U, 20U, 24U, 33U, 38U, 43U or 47U (1U = 44.45mm);
- Width: Inside – 482.6mm (19") / Outside – 750mm;
- Depth: 1000mm;
- Where specified, The Rack enclosure shall include a 2U rack mounted LCD Monitor, Keyboard and Mouse, with built in KVM switch to connect to the relevant Servers.

#### 1.11.3 Wall Mount Swing Frame Equipment Rack Cabinets

The cabinets shall be lockable and the key will be controlled by the Client.

The racks shall comply with the following specifications:

- Fixed 19" installation front, for components in accordance with IEC 297-3
- Flexible mounting for components with T-slot mountings
- Covers above and below with brush strips for cable entry and with side vent slots
- Heat dissipation discharge via a vent lid or fan top
- Door open angle 180°
- Cross connection jumper space shall be at least 100mm to the front and 50mm to the sides
- An IP20 protection rating
- Load rating shall be 50kg, static
- Height: 6U, 9U, 12U, 15U, 18U or 21U (1U = 44.45mm)
- Width: Inside – 482.6mm (19") / Outside – 600mm
- Depth: 600mm

#### 1.11.4 Rack Accessories

##### Brush Panels

The brush panels shall comply with the following specifications:

- Mountable in racks with a fixed 19" installation front or rear
- Height: 1U (1U = 44.45mm)
- Colour/Finish: Powder-coated, black
- Brush panels shall be installed above and below all BNC, Fibre and RJ45 FTP patch panels. Sufficient brush covers shall be installed to enable neat cabling and proper bending radius of cabling in the rack.

##### Cable Routing Panels

The cable routing panels shall comply with the following specifications:

- Mountable in racks with a fixed 19" installation front and rear
- Height: 1U (1U = 44.45mm)
- Colour: Front Panel – powder-coated, black
- Cable routers shall be installed in 19" racks to neaten the cables. This shall be done at the Engineer's discretion

## Shelf

The shelves shall comply with the following specifications:

- Mountable in racks with a fixed 19" installation front
- Depth: 250mm, 320mm, 450mm or 500mm
- Colour: Powder-coated, black
- Load rating shall be 20kg, static
- Shelves shall be used to install equipment without 19" rack mounting options in equipment racks

## Pull-Out Shelf

The shelves shall comply with the following specifications:

- Mountable in racks with a fixed 19" installation front
- Supplied with a handle
- Depth: 450mm or 600mm.
- Colour: Powder-coated Black
- Load rating shall be 20kg, static
- To be supplied fully assembled.

## Blank Panels

The blank panels shall comply with the following specifications:

- Mountable in racks with a fixed 19" installation front or rear
- Height: 1U, 2U, 3U, 6U or 9U (1U = 44.45mm)
- Colour: Powder-coated, black
- All open areas on the front of a supplied 19" rack are to be blanked off with the appropriate blanking panels

## Power Strips (Multi-Plugs)

The power strips shall comply with the following specifications:

- Versatile all-metal cabinet with detachable mounting flanges allows rack mount, wall mount, under counter and other creative mounting options.
- 6, 8, 12 or 16 Dedicated Socket Outlets (RED)
- 15, 20 and 30 Amp UL and CUL listed
- 4-2ay Universal Mounting
- Reset-able circuit breaker with surge protection
- The outlets shall be generously spaced to improve cable management
- Available in 19" Rack Mount, 28", 40" and 66" Lengths for Vertical or Horizontal Cabinet and Rack Mounting
- An IP40 protection rating
- The 19" racks shall be fitted with these multi-plug strips and there shall be one plug per piece of equipment installed in the rack.

### 1.11.5 Equipment and Junction Boxes

Equipment and junction boxes shall be of steel or GRP construction.

All steel shall be primed, undercoated and gloss finished with epoxy or polyurethane paint.

All boxes shall be fitted with DIN-rail mounted 2-pole 10-Amp breaker switch for termination of power cable.

All boxes shall have a box name or number on the cover.

Boxes for indoor use shall be at least IP 52 rated.

Boxes for outdoor use shall be at least IP 65 rated.

All junction boxes shall provide the facility to terminate fully the entire multi-core cable entering the box.

Boxes which shall be exposed to the sun shall face south.

Boxes shall be mounted with their sides, true vertical and horizontal.

**1.12 CONSTRUCTIONAL ASPECTS**

- 1.12.1 All holes, wire ways, trenches, etc required for this installation and made by the Contractor shall be reinstated to the original condition.
- 1.12.2 In all cases where the Contractor uses facilities provided by others, it is the responsibility of the Contractor to ensure that these are provided correctly to match his requirements. If discrepancies are found, these shall be brought to the attention of the Engineer immediately and prior to the installation of equipment.
- 1.12.3 No face-brick or other finished surfaces may be chased without the permission of the Engineer.
- 1.12.4 No cutting of structural concrete will be permitted without the permission of the Engineer.

- 1.12.5 The Contractor shall provide and erect all necessary scaffolding for this contract. Scaffolding erected by another Contractor may be utilised by the Contractor provided suitable arrangements are made with the other Contractor.

### **1.13 TESTING AND COMMISSIONING**

- 1.13.1 The successful Tenderer shall note that it is a requirement of this tender that a detailed testing and commissioning schedule be prepared for the full testing and commissioning of the complete system.
- 1.13.2 This full schedule will be available four weeks after appointment of the successful Tenderer. The testing and commissioning schedule shall be to the approval of the Engineer.
- 1.13.3 It must be noted that no piece meal hand over will be acceptable and that the entire integrated system shall be inspected and tested once all work as detailed in this detailed specification has been completed.
- 1.13.4 When the Fire Detection is ready for service, commissioning shall take place to check whether the correct quantities of equipment have been delivered and the installation is in accordance with the specifications. Commissioning shall be performed in co-operation with the successful tender's personnel and representatives of Client and Engineer.
- 1.13.5 The date of commissioning will be scheduled by the Contractor and has to be approved by the Client.
- 1.13.6 Practical Completion will only be issued once the whole of the integrated fire detection installation satisfies the operational performance requirements of the contract and the Engineer is satisfied that all security systems are capable of operating effectively.
- 1.13.7 All individual building levels and subsystems shall be thoroughly tested in the presence of, and to the satisfaction of, the Engineer or their authorised representative. Performance and acceptance testing shall include a thorough inspection (point by point) of the entire installation and verification that the installation complies with the requirements of the specification.
- 1.13.8 Performance and acceptance testing to determine whether the integrated security system achieves the required level of performance will only be undertaken after all routine testing, adjusting, commissioning, approvals and building work associated with the contract are complete and the works have been fully tested and commissioned by the Contractor.
- 1.13.9 Details of the testing required for each system and equipment shall be included in the Contractor's quality plan.
- 1.13.10 The fire detection testing and commissioning shall be conducted both during normal daylight hours and again at night after hours, as required and to the approval of the Engineer.
- 1.13.11 The Contractor shall supply all labour, materials and equipment required to fully commission and test the installation.
- 1.13.12 All costs associated in demonstrating that the fire detection performs as required by the contract, shall be borne by the Contractor.
- 1.13.13 The following testing shall be conducted:  
Factory Demonstration testing at the location nominated by the Engineer;  
Commissioning testing at the installation;  
Performance and Acceptance testing at the installation;
- 1.13.14 Testing and commissioning shall allow for any programmed staging of works as detailed in the Contractor works program. Where staging of works is applicable elements of the works may require testing on several occasions as a result of the integration/relocation and commissioning of services and equipment as building works progress.
- 1.13.15 The Contractor shall conduct all tests and inspections, as required by the Engineer, to ensure that the systems and all other works comply with the requirements of the Contract.
- 1.13.16 Equipment, which fails to operate correctly or is found to be installed incorrectly should be repaired or replaced by the Contractor. Where any test is unsuccessful the defective equipment shall be repaired appropriately and subjected to retesting.

1.13.17 The Contractor shall provide written notice of intention to test to the Engineer not less than 21 working days prior to the conduct of test.

#### 1.13.18 Factory Demonstration Test

The purpose of the factory acceptance test is to:

Demonstrate that the system being provided by the Contractor operates as specified in the tender documentation. It is not expected that the full system be operational at this time, but that each sample subsystem under test, can be demonstrated to its full potential in a system environment;

Allow the opportunity for all stakeholders and involved parties, to physically observe and operate the system and to provide input and feedback for final system configuration to ensure the clients needs and requirements have been fully addressed;

Allow a final opportunity to consider possible design changes, with minimum impact on costs and integration during the construction phase;

Finalise the design and functionality of the system configuration;

Present a methodology and the documentation of procedures to be used during the commissioning phase of the project;

The factory demonstration shall include, as a minimum:

Operational samples of all equipment proposed to be supplied as part of the contract;

An operational model (limited in scale) of the sample equipment to demonstrate the functionality of each sub-system that comprises the fire detection and security services system;

The operational model shall demonstrate the overall alarm handling, monitoring, reporting and methodology of operation of the proposed integrated fire detection and security services system;

Factory Demonstration Test Specification

Supply a factory demonstration test specification to the Engineer for comment a minimum of 28 days prior to the demonstration date. The factory demonstration test specification shall include as a minimum:

- Introduction providing an overview of the factory demonstration aims, test procedures and agenda;
- Functional block diagram of the test demonstration detailing equipment and connectivity (including interfaces) for the test session;
- Restrictions on equipment operation for the test e.g. RF devices which may be connected via line to simulate field operation;
- List of equipment being used in the demonstration including any test equipment or additional equipment used in the demonstration;

Detailed test procedures fully describing:

- The specification requirement being demonstrated
- The exact procedure to be implemented to demonstrate compliance with the specified requirement
- The expected outcome from the demonstration
- Test result check boxes i.e. pass/fail.
- Remarks field to provide additional clarification as a result of the demonstrated function.
- Factory test sign-off sheet for the Contractor and Engineer authorized representatives to confirm test results.

#### Factory Acceptance Elements

Fully detailed block diagrams, shall be available for inspection at the factory acceptance test, which clearly show all elements of the various subsystems and the interrelationship between all systems.

#### 1.13.19 Commissioning

The testing of the system shall be done in the presence and to the satisfaction of the Engineer and Client.

The Contractor shall fully test and commission all fire detection and security services to ensure that correct operation of all systems prior to final performance and acceptance testing with the Engineer. Tests shall include simulation of fire conditions in each zone to prove the efficiency of all aspects of the system to the satisfaction of the department.

All equipment, material, etc., which may be necessary for these tests shall be supplied by the Contractor, including a suitable smoke generator.



The Contractor shall do his own complete commissioning tests before the actual first take-over tests are done. This is to satisfy himself that everything is working and is in accordance with the specification.

During the conduct of commissioning the Contractor shall:

- Confirm that all equipment is fully operational and provides the required functionality;
- Provide a comprehensive final commissioning report outlining all test results;
- Constructed details, performance test data on all cables and any other information deemed necessary for future records;
- Supply all labour, materials and equipment required to fully commission and test the installation to the satisfaction of the Engineer;
- Allow for minor programming changes as a result of testing and commissioning and/or final performance and acceptance testing;
- Repair or replace any equipment that fails to operate correctly, or is considered by the Engineer, to be installed incorrectly;
- Supply all passwords installed as part of these works to the Engineer;

#### 1.13.20 Performance and Acceptance Testing

Final performance and acceptance testing to be conducted with the Engineer shall, as a minimum, include:

- Physical inspection of each point and device;
- Test function of each point and device;
- Test alarm response and annunciation of each point and device;
- Check logging and recording of activity for each alarm point and device;
- Test required interface with other systems for each alarm point and devices;
- Confirmation that each system performance complies with the project specification;

On completion of the works the Contractor shall satisfy the Engineer that the security services installation operates in accordance with the requirements of the contract.

### 1.14 TRAINING

#### 1.14.1 General

Prior to commissioning of the installation the Contractor shall provide comprehensive training of all security staff and nominated maintenance personnel, to the approval of the Engineer and the Client. Maintenance staff demonstrates a complete understanding of the location and connectivity of the various elements of the security services installation.

All training aids and course notes necessary to conduct effective operational and maintenance training shall be supplied by the Contractor. The training venue will be made available on Site by the Client.

The training documentation must be submitted to the Engineer for evaluation and approval. No training will commence on site prior to the written approval of the Engineer. Should the Engineer not approve the drawings all documentation will be referred back to the Contractor for re-evaluation and submission to the Engineer.

Documentation must be sent to the Engineer at least 12 working days prior commencement or scheduling of training programs of the operational staff on site.

#### 1.14.2 Operator Training

Training shall be comprehensive, covering all aspects of systems installed as part of these works. The Contractor shall provide a detailed program to the Engineer, for comment and review, no less than 12 days prior to the commencement of training.

Each group of trainees should receive a minimum of an -hour training session. Allow to fully train 3 groups, each of up to 4 personnel. (The amount of personnel sent for training are to the full discretion of the client).

Training shall be adequate to ensure that the groups trained are:

- competent in the operation of systems;

- adequately trained to carry out ongoing training;
- fully aware of the location of all equipment installed as part of this Contract within their area of responsibility;

## **1.15 PRACTICAL COMPLETION**

### **1.15.1 Practical completion will only be granted when:**

Testing and commissioning of each system has been completed.

Testing of the integration of all sub systems in totality has been satisfactorily demonstrated.

The Engineer is satisfied that the system is operating in the correct and specified manner. All systems equipment has been proven to operate faultlessly for a total period of two weeks following the successful commissioning of the complete security systems.

All operators and maintainers have been trained to a satisfactory level of competency.

All information has been supplied to the Engineer for final approval. This includes all documentation as specified in this contract.

## **1.16 DEFECTS LIABILITY**

### **1.16.1 Full Fire Detection Installation Maintenance during Defects Liability**

The Tenderer shall note that a one year full maintenance period shall be applicable on all aspects of the work done under this contract effective from the date of practical completion.

Without additional charge, renew any Works implemented to meet the requirements of this contract which prove to be faulty from workmanship or materials, and 'fully maintain and service' the whole installation during the defects liability period.

"Fully maintain and service" shall include:

- Monthly inspection and test of the system to verify continued operation of the system in accordance with the performance parameters specified in the specification;
- Assessment of system reports to ensure continued performance reliability of the system and associated devices;

The contract shall record all works carried out during each visit and forward copies of all records to the Engineer within 7 days of the conduct of the monthly visit

The Contractor shall deliver a proposed maintenance program to the Engineer, for approval, 14 days prior to commencement of Commissioning testing. This shall include full a full back-up service for all the equipment and cabling rendered installed as well as all software installed by the successful Tenderer under this contract.

The Tenderer shall in his price fully state the monthly charge for the above inclusive of his additional rate for labour for any after hour work required.

### **1.16.2 Call Outs during Defects Liability Period**

The Contractor shall attend on site within two (2) hours of notification of a failure of the equipment and associated systems.

The call out during the defect liabilities period requirement shall apply on a 24 hour day, 7 day a week basis.

The Contractor shall forward details of contact staff, suppliers, agents and/or representatives to be used to provide after hours call out service to the Engineer, for approval.

The provided details shall indicate staffing levels, roster of after hour's on-call personnel, spare parts holdings, systems experience and qualifications.

Failure to attend on site within the specified period of two (2) hours shall allow the client to recover costs from the Contractor. Recovery costs may include, but are not limited to:

- Additional labour costs, including penalty rates, occurring as a result of the failure of the security services.

- Costs associated with the provision of alternate equipment used to provide temporary resolution of a fault condition. This may include supply, transport, installation and decommissioning costs associated with the provision of temporary facilities.

The contract shall adhere to the Engineer defined security procedures for access to and during site attendance over the defect liability period.

## **1.17 POST CONTRACT MAINTENANCE AGREEMENT**

1.17.1 If the Client requires it, Contractors shall be able and willing to maintain their installed equipment for a period of at least five years after completion of the contract. This will be arranged through a maintenance contract, which will be negotiated during the free maintenance period.

1.17.2 Such maintenance contract may be either of the following general types:

Extended guarantee maintenance contract. Under this type of maintenance agreement the Contractor undertakes to maintain the installation in a good working condition for a fixed price which is independent of the number of maintenance visits which he has to make. Preventative maintenance visits at agreed intervals are included in the price. (The cost of replacement parts may or may not be included in the fixed price.)

Preventative plus breakdown service maintenance. Under this type of maintenance agreement the Contractor undertakes to do preventative maintenance visits at agreed intervals for a fixed fee. Further call-outs will be on breakdown only and are charged at hourly and km rates. The cost of replacement parts is extra.

## **1.18 FINAL DOCUMENTATION**

### **1.18.1 Close-Out Documentation**

The Tenderer shall note that after the completion of the contract three sets of all operating, maintenance, training manuals and a complete spares list for all of the equipment and software installed (together with two local agency telephone numbers where the above can be obtained), shall be handed to the Client.

The Tenderer shall at the end of the contract update all the drawings that were issued to him during the contract with a red pen and hand them over to the Engineer for finalisation and completion of his contractual obligation regarding drawings.

The Tenderer shall note that he shall provide with the above documentation a list including all the required contact details and emergency telephone numbers.

The Operator's Manuals must be compiled in such a way and contain enough detail information to enable a suitably qualified Engineer or technician to control and operate the full installation without any training from the Contractor. The Operator's Manuals must be a separate set of documents from the Maintenance Manuals.

Irrespective of the abovementioned, the Operator's Manuals must also contain short form instructions to enable trained operators (trained by the Contractor) to operate the full installation.

Maintenance Manuals shall incorporate operator's instructions must contain one (1) set of final drawings as mentioned above.

Information of all subsystems, components, etc, of each part of the installation must be supplied, also indicating the position of each component, the manufacturer, the type, the series number, IP address, MAC address, performance data, i.e. full detail to enable any outside party to perform comprehensive maintenance of the total installation.

Routine control tests as well as inspections that must be performed on individual components or parts of the installation must be indicated. The various intervals and periods, at which these tests and inspections must be performed, must also be mentioned.

All of the above shall form part of the as-built documentation.

All the required documentation shall be to the satisfaction of the Engineer and of the Client.

### **1.18.2 As-Built Drawings and Schematic Diagrams**

As each portion of the work is completed, mark-up (red-line) drawings shall be provided by the Contractor showing the exact location measured from fixed points of all cables, cable routes and equipment. Cable routes shall be marked and coordinated on the drawing every 5m. The Contractor shall also provide mark-up schematic diagrams for all the equipment he/she installed on site.

The Contractor is only required to provide as-built drawings of the relevant sections of the installation that he/she worked on. If there are no existing drawings, provide a schematic diagram of the relevant sections.

Cable schedules must be supplied, including the following:

- The number of cables mutually connected between field units and the control unit(s);
- Cable sizes, number of conductors in each cable, number of reserve cables, etc.;
- Cable types, voltage, technical references of the cables;

Schedules containing full details with respect to interconnecting cable schedules, their size, rating, connecting terminal detail and connecting references must be included in the maintenance manuals. The installation is not regarded as complete until all mark-up drawings and schematic diagrams have been received and signed for by the Engineer.